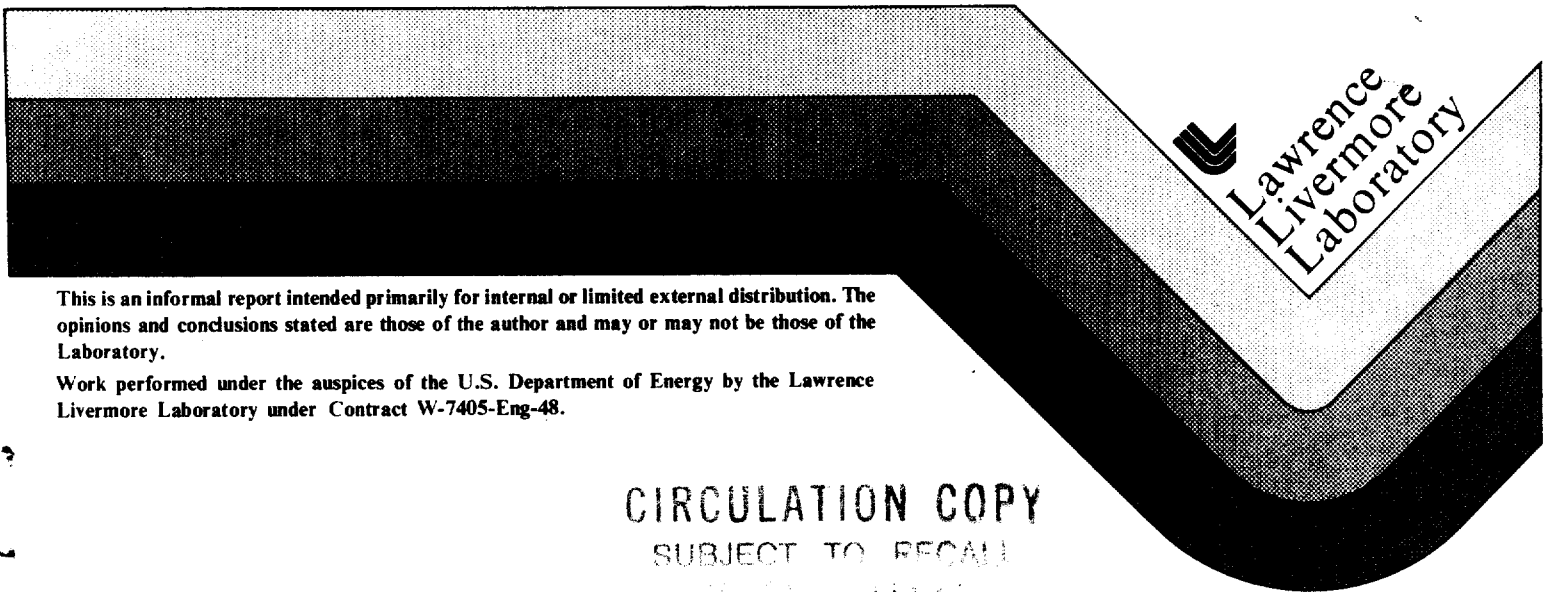UCID- 18728

ENGINEERING RESEARCH DIVISION REPORT OF REPORTS

CALENDAR YEAR 1979

E. K. Miller, Division Leader

C. L. Gardner, Editor
S. J. Johnston, Editor

March 1980

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SUBJECT TO RECALL

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ACKNOWLEDGMENT

ENGINEERING RESEARCH DIVISION
REPORT ON REPORTS - CALENDAR YEAR 1979

Introduction

Each year the Engineering Research Division of the Electronics Engineering Department has issued an internal report listing all formal publications produced by the Division during the calendar year.

79-1   CROSS-BOREHOLE GEOPHYSICAL PROBING FOR SITE   R. J. Lytle
        CHARACTERIZATION   J. Condon
            UCRL-82103, January 4, 1979
            Presented at the Society of Mining Engineers,
            Atlanta, Georgia, June 18-21, 1979

Abstract

Prior to excavation in soil and rock, it is useful to know the subsurface structure. This is important information both for safety and for equipment scheduling reasons. It is useful to know whether parts of the subsurface might be potentially troublesome or of different character than is generally present. By using geophysical probing, it is possible to infer the location and size of these unusual regions.

The ground structure is commonly estimated from core sample's taken from boreholes. These cores give a detailed knowledge of the structure in the borehole. However, knowledge of the structure exterior to the borehole can only be extrapolated from core data. By using seismic and electromagnetic cross-borehole geophysical probing, remote probing can be used to sense the region exterior to boreholes. A recent advance has significantly improved the state-of-the-art for defining the ground structure between boreholes. This new procedure utilizes large amounts of data and provides a detailed picture of the subsurface. The data processing algorithms used are similar to those in medical imaging of the human body using x-rays, a science called x-ray tomography. This imaging of the ground is called geotomography. Several examples of geotomography applied to imaging ground structure will be presented.

79-2   DEPARTMENT OF ENERGY'S SOLAR TECHNOLOGY TRANSFER   H. W. Newkirk
        PROGRAM: THE LAWRENCE LIVERMORE LABORATORY
        EXPERIENCE
            UCRL-81013, January 5, 1979
            Presented at the Conservation Technologies
            Symposium-Workshop, Miami Beach, Florida

Abstract

The Lawrence Livermore Laboratory (LLL) under the direction of the Department of Energy's (DOE's) Solar Technology Transfer Program (STTP) has designed and implemented a regionalized solar commercialization outreach program. Primary target audiences in Arizona, California, Hawaii and Nevada include architects, builders, lenders, contractors, plumbers, manufacturers, distributors as well as education institutions, state and local offices, and library systems. The experience gained during this initial LLL/STTP program will be of value to the coming solar technology transfer and commericalization activities now being planned by the Solar Energy Research Institute (SERI), regional SERI's, the Energy Extention Service, and the National Solar Heating and Cooling Information Center.

79-3   TWO-DIMENSIONAL RECURSIVE FILTER DESIGN: M. P. Ekstrom
A SPECTRAL FACTORIZATION APPROACH   R. E. Twogood
     UCRL-82130, January 5, 1979   J. W. Woods
     Published in the IEEE Trans. on Acoustics,
     Speech, and Signal Processing

Abstract

This paper concerns development of an efficient method for the design of two-dimensional recursvie digital filters. The specific design problem addressed is that of obtaining half-plane recursive filters which satisfy prescribed frequency response characteristics. A novel design procedure is presented which incorporates a spectral factorization algorithm into a constrained, non linear optimization approach. A computational implementation of the design algorithm is described and its design capabilities demonstrated with several examples.

79-4 Cu_xS/CdS CELL FORMATION UTILIZING REACTIVE   G. A. Armantrout
SPUTTERING TECHNIQUES - TECHNICAL STATUS REPORT
COVERING THE PERIOD 1/1/77 to 6/30/78
     UCID-18025, January 10, 1979

Abstract

The parameters governing Cu_xS film formation using reactive sputtering techniques have been studied in detail. It has been found that the partial pressure of H_2S is the governing parameter and must be carefully controlled. Substrate temperature is also important, and increasing substrate temperatures yield films with a high chalcocite content over a wider range ppH_2S values. The Cu_xS films are reproducible and have optical and electrical properties similar to the better chalcocite films formed by copper ion exchange techniques.

Cells made by Cu_xS deposition onto evaporated CdS have been made with efficiencies up to 4% in sunlight. The interface has been

shown to be epitaxial in nature with a reasonable value of interface recombination velocity. Analysis of the cells using optical and SEM EBIC techniques has identified the existence of an anomalous layer on the CdS surface which adversely affect I_{SC}. Cells which are formed using etched CdS substrates suffer significant shorting and current collection problems. These problems are shown to be caused by the CdS surface topography when the Cu_xS is sputtered onto the surface.

Major changes are planned in the cell fabrication procedure which include the use of sputtered CdS substrates doped with indium and the complete formation of the heterojunction without breaking vacuum. Fixturing changes on a new sputtering system capable of this fabrication procedure are underway and initial results on all-sputtered cells should be available by the end of the next quarter.

79-5   THE SYSTEMATIC COMPUTATION OF THE PERFORMANCE   J. H. Yee
OF PHOTOVOLTAIC CELLS BASED ON FIRST PRINCIPLES:
FIRST REPORT
UCID-18041, Part I, January 29, 1979

Abstract

The minority lifetime and the minority diffusion length were theoretically estimated for both the single crystal and the polycrystalline film of Cu_2S, Cu_2O and CdTe. The mobility of the electron as a function of the temperature was calculated for the Cu_2O single crystal based upon the simple model of the electron-polar optical phonon interaction. It was shown that the existing data on the hole mobility of Cu_2S can be explained very well by a simple model of grain boundary scattering.

The effect of impurity and defect on the minority carrier lifetime and the minority diffusion length were discussed. A new model for the energy structure of Cu_2S was proposed. This new energy band model explains very well the experimental data for the absorption coefficient.

79-6   THE SYSTEMATIC COMPUTATION OF THE PERFORMANCE   J. H. Yee
OF PHOTOVOLTAIC CELLS BASED ON FIRST PRINCIPLES:
FIRST REPORT
UCID-18041, Part II, January 30, 1979

Abstract

The optical absorption coefficient for the ternary compound $ZnSiAs_2$, and the binary compounds GaAs and CdTe are theoretically calculated, based upon the pseudopotential technique. The experimental absorption coefficiency of GaAs agrees very well with the calculated absorption coefficient.

Computer simulation was carried out for the heterojunction CdTe-CdS and InP-CdS and Schottky Barrier InP and Cu_2O solar cells. The theoretical result for CdTe compares favorably with the experimental result.

Detailed derivation of the diffusion length for the thin film material together with some numerical results for the diffusion length of CdTe and Cu_2O are presented. Interface phenomena for the Schottky Cu_2O is also discussed.

79-7   DDET - A PROGRAM WHICH SIMULATES ON-LINE   G. Myers
        DETECTORS
        UCID-18106, January 1979

Abstract

DDET - A PROGRAM WHICH SIMULATES ON-LINE DETECTORS

DDET is a computer code which was developed for the purpose of simulating and evaluating the performance of on-line detectors for use in safeguarding special nuclear materials (SNM) being processed. The program is designed to be used in conjunction with the programs DYNSYL (1) and DYNEST (2). DDET consists of an executive routine which presently contains in its library two likelihood ratio detectors. The code structured in a modular fashion so that additional detectors can be easily implemented by the user.

79-8   SAFEGUARDS SIGNAL PROCESSING TASK QUARTERLY   D. R. Dunn
        REPORT (NRC MATERIAL CONTROL & ACCOUNTING
        PROGRAM)
        UCID-18108, January 1979

Abstract

Activity for the quarter October-December 1978, in the Safeguards Signal Processing Task, Material Control Safeguards Evaluation Program, is summarized. Progress was made in chemical process model development, material estimator/detector model development, and physical security monitor characterization.

79-9   SPECIFICATIONS FOR GERMANIUM RADIATION DETECTORS W. J. Orvis
        USED FOR GAMMA RAY ASSAY   G. A. Armantrout
        UCRL-52639, January 1979
        Published in NRC - NUREG/CR-0562

Abstract

Nondestructive assay by gamma ray spectroscopy is one of the preferred methods of nuclear material inventory. Germanium diodes are currently some of the most useful detectors available to carry out this work. This usefulness is due to the high resolution and

relative efficiency of the devices. We investigated the current state of affairs of both high-purity and lithium-drifted germanium diode technology. In this report, we discuss the physics and engineering of detector fabrication and operation and the basic principles of assay by gamma ray spectroscopy. Finally, we discuss the trade-offs for detectors used in several general assay categories, and we examine the outputs. Since we found no ideal system for all situations, we have listed the various specifications parameters, explained their meanings, and discussed their relevant trade-offs.

79-10 PROSPECTS FOR GENERATING 1-10 TPa PRESSURES R. S. Hawke
WITH A RAIL GUN J. K. Scudder
UCRL-82296, February 2, 1979 W. J. Nellis
Presented at the Int'l Assoc. for the Advance
of High Pressure Science and Technology

Abstract

It has been demonstrated that a plasma arc can be accelerated along two current carrying parallel rails and used to accelerate a projectile (1). We have performed an extensive analysis and found the task of using a railgun to accelerate an impactor plate to velocities of 10-40 mm/μs to be feasible with contemporary technology. This range of impact velocities would enable shock pressures of 1-10 TPa to be generated for EOS research.

79-11 LOCATING A HORIZONTAL BOREHOLE IN THE EARTH E. F. Laine
USING HIGH FREQUENCY ELECTROMAGNETIC PROBING J. T. Okada
FROM VERTICAL BOREHOLES
UCRL-82302, February 2, 1979
Presented at the Annual Int'l Meeting,
New Orleans, LA, November 4-8, 1979 and
submitted to the Mining Magazine, London,
England, Society of Exploration Geophysicists.

Abstract

A three inch horizontal borehole, 165 ft. deep and 700 ft. long, was accurately located in depth and direction. High frequency electromagnetic (10 MHz) CW transmissions were made from the horizontal borehole to vertical boreholes nearby. Using the absolute received signal amplitudes the distance of the signal from the receiver was calculated. Verification of the accuracies were obtained by using gamma ray sources. This investigation was for the LLL in-situ coal gasification program. The horizontal borehole was directionally drilled (30° from horizontal) from the surface deviating about 5°/100 ft. to obtain a final 200 ft. horizontal hole in a 25 ft. thick coal seam. The magnetic logging of the hole contained a large error, therefore, the intersecting holes could not be drilled until the actual horizontal hole traverse was located.

79-12 TIME DOMAIN SOLUTIONS VIA INTEGRAL EQUATIONS E. K. Miller
    UCRL-82322, February 5, 1979
    Presented to the Theoretical Methods for
    Determining the Interaction of
    Electromagnetic Waves with Structures,
    Univ. of East Anglia, Norwich, Norfolk,
    England, NATO Advanced Study Institute,
    July 23 - August 4, 1979

Abstract

Since the formulation of Maxwell's Equations, it has been
appreciated that direct time-domain solutions are possible, at
least in principal. However, it required the advent of the digital
computer to make such solutions a practical reality, since even
more than the better known frequency-domain techniques, time-domain
methods are computationally demanding. In spite of that
characteristic, significant progress has been made in the past 10
years in formulating and solving a wide variety of time-domain
problems. It is the purpose of these lectures to summarize the
current status of time-domain solutions achieved via integral
equations.

The first lecture will concentrate on treatment of wire-like
objects. A brief analytical introduction will be followed by
discussion of the numerical solution procedure, which is
implemented using the moment methods. Next, applications will be
demonstrated for several radiation and scattering problems, chosen
to emphasize some of the advantages peculiar to time-domain
techniques. Interpretation of the underlying physical behavior
made possible by the unique perspective of a transient solution
will also be stressed. The lecture will conclude with discussion
of experimental validation through transient measurements.

79-13 NATURAL MODEL METHODS IN FREQUENCY DOMAIN E. K. Miller
    ANALYSIS
    UCRL-82323, February 5, 1979
    Presented to the Theoretical Methods for
    Determining the Interaction of Electromagnetic
    Waves with Structures, Univ. of East Anglia,
    Norwich, Norfolk, England, NATO Advanced Study
    Institute, July 23 - August 4, 1979

Abstract

Electromagnetic fields, as is true of many physical phenomena, are
described by second-order differential equations whose source-free
solutions are exponential in the time domain. This basic fact has
led to the Singularity Expansion Methods (SEM) as a way to
characterize transient EM fields in terms of complex resonance
frequencies. Such resonance frequencies, or poles as they are
called from complex variable theory, can provide a way to develop

the transient or spectral response of an object to arbitrary excitation. A necessary condition for this to be possible is that a method for finding the objects poles must be available, the realization of which is the primary topic of this lecture.

A number of techniques have been explored for obtaining the EM poles of antennas and scatters. Some involve exploration of the complex frequency plane, and as such are not applicable to experimental data. Prony's Method however, is useful not only for computed or measured transient response data, but also with slight modification for spectral data as well. Its analytical development will be outlined and its application demonstrated for various types of data and objects. Use of poles for target identification from both transient and spectral data will also be considered. The lecture will conclude with a discussion of other ways in which poles arise and can be useful in electromagnetics.

79-14   WIRES & WIRE GRID MODELS, INCLUDING TRANSFER   E. K. Miller
AND MUTUAL ADMITTANCE
UCRL-82324, February 5, 1979
Presented at the Theoretical Methods for Deter-
mining the Interaction of Electromagnetic Waves
with Structures, Univ. of East Anglia, Norwich,
Norfolk, England, NATO Advanced Study Institute,
July 23 - August 4, 1979

Abstract

The modeling of wire objects has continued to occupy a place of central importance in electromagnetics. There are several reasons for this. First, wires received the majority of attention during the early formative years of electromagnetic computer modeling. Second, many problems of practical interest involve wire-like geometrics. Third, wires can be employed to model surface objects through the use of wire grids, albeit with some sacrifice of efficiency. Finally, and by no means least significant, wire objects are inherently more attractive computationally, because they involve a linear sampling, rather than the area of volumetric sampling associated with the modeling of conducting surfaces or dielectric volumes. This lecture will survey wire modeling from an applications viewpoint.

The topic will be introduced by briefly summarizing some analytical aspects of wire modeling. This will be followed by discussing the numerical treatment by which the formulation is reduced to a form suitable for computation. Then, examples of applications will be presented to illustrate various features of wire modeling, including radiation and scattering problems, near and far field effects, impedance characteristics, interaction with the ground, etc. Some concluding remarks will be directed to validating results, and summarizing various commonly available computer code.

79-15   A SYSTEMATIC APPROACH TO NUCLEAR SAFEGUARDS   S. Weissenberger
        DECISION-MAKING   B. Judd
        UCRL-81977, February 6, 1979
        To appear in the Management Science Magazine

Abstract

The regulatory decision on how safe a safeguard nuclear facility should be depends on a trade-off between diversion risk and the cost of reducing that risk. Given that one plans to build the plant, the optimum level of safeguards is achieved when the cost of further risk reduction exceeds the benefit from lower risk. This paper develops quantitative models of factors which influence this risk/cost trade-off. A basic conceptual structure is presented, and a detailed example is used to illustrate the methodology for optimal regulation setting.

79-16   NEW QUASISTATIC REPRESENTATION FOR SOMMERFELD   J. N. Brittingham
        INTEGRALS   G. J. Burke
        UCRL-82310, February 7, 1979
        Presented at the National Radio Science
        Meeting, Seattle, WA, June 18-22, 1979

Abstract

In the past to evaluate the electromagnetic field near a lossy interface, a Quasistatic approximation which required use of an approximation in the integrals that was not rigorously justified. In this paper, the electric field from a vertical electric dipole near the interface was developed by a new procedure and compared to other Quasistatic results in the literature. The new method consist of rewriting the Sommerfeld integrals into new form that separate the integrals singular part near the interface from the non-singular part. Since the singular integrals dominate the field behavior near the interface it remains only to evaluate these integrals. The singular integrals are evaluated exactly to find a mathematically rigorous representation for the electric field near the interface.

79-17   THE CLMG COMPUTER CODE FOR A RELATIVISTIC   R. M. Bevensee
        MAGNETRON
        UCRL-82321, February 8, 1979
        Presented at the 1979 IEEE Int'l Conf on
        Plasma Science, June 4-6, 1979

Abstract

The Stanford Linear Accelerator Electron Trajectory Program is rewritten to treat the d.c. current flow between cathode and anode in the cross section of an infinitely long magnetron tube. The system is treated as two-dimensional, but the equations of motion could be modified to allow for axial velocity. An external d.c.

magnetic field is initially assumed, although the code allows a general spacial distribution. A d.c. anode voltage is assumed. Initially Laplace's equation is solved then the fully relativistic electron trajectories are computed in the Laplace field and the resultant space charge and current are stored. These determine a Poisson equation solution for scalar potential $V(r)$ and magnetic vector potential $A(r)$. Then the trajectories, space charge, and current flow are recomputed. By iterating this procedure the code coverages on self consistent solutions of all the equations.

Poisson's equation (initially Laplace's equation) for V and for the rectangular components of A is solved by finite difference equations using a relaxation method (the "semi-iterative Chebyshev") described by Varga. The electron ray trajectories are computed from a starting surface a short distance from the cathode by first obtaining the current in each ray by the Langmuir-Blodgett equation for full space charge, modified for the current returning to the cathode and by the presence of the magnetic field. The relativistic differential equations of motion are then solved using a fourth-order Runge-Kutta method, in which the electric fields are obtained by finite differencing of the scalar potential and the self magnetic field is obtained as the finite difference curl of A. There are no explicit radiation loss terms in the equations of motion.

79-18   INVERSION OF ONE-DIMENSIONAL SCATTERING DATA   E. K. Miller
        USING PRONY'S METHOD   D. L. Lager
        UCRL-52667, February 12, 1979

Abstract

A one-dimensional configuration is the simplest geometry to invert, yet it has practical application to such problems as scattering from inhomogeneous half-spaces and propagation on nonuniform transmission lines. Whether the medium parameters vary continuously or discretely with position, the problem's numerical description can usually be developed in a finite-difference approximation. As such, the scattered and transmitted fields can be represented as exponential series, whose exponents are related to the electrical thicknesses of the layers which make up the model. If the exponents or poles are derivable from field data, then the inverse problem is formally solvable. This report considers application of Prony's method, a procedure for obtaining the poles of exponential signals, to such one-dimensional problems. Analysis of both time-domain and frequency-domain data is studied. The effects of the medium characteristics, number of layers, and other factors are examined. It is concluded that Prony's method has merit for certain classes of one-dimensional inverse problems.

79-19   LINEAR ARRAY SYNTHESIS USING PRONY'S METHOD   E. K. Miller
         UCRL-82363, February 12, 1979   G. J. Burke
         Presented at the Int'l IEEE/AP-S Symposium
         and Nat'l Radio Science Meeting, Seattle, WA,
         IEEE and URSI, June 18-22, 1979

Abstract

Prony's method has found an increasing variety of applications in
electromagnetics. This is because it provides a straightforward
way to obtain the poles and residues of functions which are sums of
complex exponentials. Such functions occur commonly in physics,
particularly in areas which involve wave phenomena. These include
acoustics, structural behavior and, of course, electromagnetics.

Electromagnetic applications range from characterizing spectral and
temporal responses to representing bistatic scattering and
radiation patterns. The latter area is the one of concern in this
presentation, which addresses the specific problem of antenna
synethesis. As shown earlier (E. K. Miller and D. L. Lager,
"Radiation Field Analysis and Synthesis Using Prony's Method,"
Electronics Letters, March 16, 1978, Vol. 14, No. 6, pp. 180-182.)
the patterns of linear source distributions can be processed using
Prony's Method to either determine the actual discreet source array
which produced the pattern (i.e., to image the source distribution)
or to develop an equivalent discreet array which matches the
original pattern (to synthesize a source distribution).

Our attention is focused specifically on antenna synthesis.
However, in contrast to our previous work where the pattern being
synthesized was derived from a prescribed continuous aperture
distribution, we now start from the prescribed pattern itself.
This distinction is important, because there is not a prior
assurance that an arbitrarily prescribed pattern will be realizable
with the exponential source-field relationship required both by
Prony's Method and physical reality.

Results are given here for several pattern types to demonstrate the
outcome of using Prony synthesis. A pattern found to be especially
useful is one given by $\sin^N(\theta)$ where $N\sim100$ gives a half power
beamwidth~10 degrees. The performance of an actual (computer
modeled) array of wire dipoles designed to radiate a given pattern
is illustrated, and its sensitivity to errors in electrical and
mechanical parameters is discussed.

79-20   MAXIMIZING THE GAIN-BANDWIDTH PRODUCT OF A   R. M. Bevensee
         LOSSY LINEAR ANTENNA
         UCRL-82325, February 13, 1979
         Presented at the National Radio Science Meeting,
         Univ. of Washington, USNC/URSI, June 18-22, 1979

Abstract

Maximization of the G-BW product of the general 2-port antenna will be discussed. An expression for the maximum product at driving port 1 will be derived, assuming optimized 2-port network parameters and reactive loading at port 2. The maximum product is inversely proportional to rate of change of input reactance relative to frequency at port 2 (with port 1 open circuit). The energy theorem is invoked to relate this to stored energy. A lower bound on stored energy is derived by assuming each closed contour of energy around the antenna is related to the real power flow (constant) by the factor c, the velocity of light. The effective volume of stored energy is estimated for practical antennas from some unpublished work of the author.

The result of the analysis is an expression for the maximum G-BW product in terms of the unloaded antenna parameters. The expression shows a critical dependence on the input resistances at both ports.

79-21   MAGNETICALLY LAUNCHED PROJECTS FOR HIGH   R. S. Hawke
         PRESSURE RESEARCH AND IMPACT FUSION   J. K. Scudder
            UCRL-82340, February 15, 1979
            Presented at the APS Meeting on Shock
            Waves in Condensed Matter, June 11-13, 1979,
            Pullman, Washington, D.C.

Abstract

A mathematical model describing the railgun-type magnetic propulsion apparatus is tested with the ANU launch data to 5.9 km/s. The expectations of increasing the launcher's performance to the 10-35 km/s range for EOS experiments with 10-45 g projectiles are shown to be reasonable and to be a logical step towards impact fusion threshold velocities beyond 150 km/s.

79-22   PARAMETRIC CHARACTERIZATION OF RANDOM PROCESSES   W. D. Smith
         USING PRONY'S METHOD   D. L. Lager
            UCRL-52673, February 16, 1979

Abstract

The compact parametric characterization of a random process if often valuable in problems involving signal classification and system identification. The method of Prony suggest two different approaches to obtaining such a characterization from a finite record of sampled data. The first approach is superior for the accurate parametric characterization of a stationary process. Alternately, the more precise second approach is best for monitoring changes with time in random process parameters.

79-23 NEC - NUMERICAL ELECTROMAGNETICS CODE FOR   G. J. Burke
       ANTENNAS AND SCATTERING   A. J. Poggio
          UCRL-82350, February 16, 1979   J. C. Logan
          Presented at the Int'l IEEE/APS Symp.,   J. W. Rockway
          Univ. of Wash., June 18-22, 1979

Abstract

The Numerical Electromagnetics Code (NEC) is a computer program for
analyzing the electromagnetic response of an arbitrary structure
consisting of wires and surfaces in free space or over a ground
plane. The analysis is accomplished by the numerical solution of
integral equations for induced currents.

The code combines an integral equation for smooth surface with one
specialized to wires to provide convenient and accurate modeling of
a wide range of structures. A model may include nonradiating
networks and transmission lines connecting parts of the structure,
perfect or imperfect conductors, and lumped-element loading. A
structure may also be modeled over a ground plane that may be
either a perfect or imperfect conductor. Several different
excitation options are available.

The output may include current and charge density, near or far zone
electric or magnetic fields, and impedance or admittance.

79-24 EVALUATION OF THERMOMETRICS THERMISTORS   W. J. Orvis
       FOR USE AT CRYOGENIC TEMPERATURES
          UCRL-84263, February 19, 1979
          Published in the Nuclear Instruments and Methods

Abstract

Two types of Thermometrics, Inc. thermistors have been evaluated at
cryogenic temperatures by calibrating them against a type T
thermocouple. They are both bare bead thermistors types BB25JE350R
and BB25JE020M. The resistance of the thermistors was measured
using a Hewlett-Packard 3467A Logging Multimeter which uses a
constant current method of resistance measurement. Favorable
results were obtained for the second type of thermistor down to the
boiling point of liquid nitrogen (-196 C) by decreasing the
interrogation current of the multimeter. This decrease was
necessary to minimize self-heating effects.

79-25 SPECIFICATIONS FOR GERMANIUM RADIATION DETECTORS   W. J. Orvis
       USED FOR GAMMA RAY ASSAY IN SAFEGUARDS   G. A. Armantrout
       APPLICATIONS (SUMMARY)
          UCRL-82372, February 22, 1979
          Presented at the Institute of Nulcear
          Materials Management, Albuquerque, NM

Abstract

Nondestructive assay by gamma ray spectroscopy is one of the preferred methods of nuclear material inventory. Germanium diodes are currently some of the most useful detectors available to carry out this work. This usefulness is due to the high resolution and relative efficiency of the devices. We investigated the current state of affairs of both high-purity and lithium-drifted germanium diode technology. In this paper, we discuss the trade-offs for detectors used in several general assay categories, and we examine the electronics and systems used to process the detector outputs. Since we found no ideal system for all situations, we have listed the various specifications parameters, explained their meanings, and discussed their relevant trade-offs.

79-26   A STRUCTURED APPROACH TO SAFEGUARDS ASSESSMENT   A. A. Parziale
       UCRL-82207, February 26, 1980   I. J. Sacks
       Presented at the INMM Conference, July 16-19, 1979, Albuquerque, NM

Abstract

Lawrence Livermore Laboratory has developed the Structured Assessment Approach (SAA)[1,2,3,4] in assisting the U.S. Nuclear Regulatory Commission (NRC) in the establishment of safeguard assessment tools for the analysis of material control and accounting systems. The SAA assists the NRC in verifying safeguard system design compliance with NRC regulations. The SAA is a staged approach which establishes specific and well defined inputs and outputs and which offers the efficiences associated with controlled and guided analysis via computer automation with NRC analyst interaction. The SAA has recently been applied in the analysis of a safeguard system at a nuclear processing facility.[1]

79-27   SAFEGUARDS DESIGN WITH PETRI NETS   A. A. Parziale
       UCRL-82208, February 26, 1979   I. J. Sacks
       Presented at the INMM Conference, July 16-19, 1979, Albuquerque, NM

Abstract

Lawrence Livermore Laboratory is currently using the logic structure of Petri Nets[5,6] in both the assessment and design of safeguard systems associated with special nuclear material control and accounting. The Petri Net has exhibited a powerful modeling capability toward analyzing material control and accounting system vulnerability to an adversary who tampers to achieve (and cover) the diversion of material. A technique based on Petri Nets has been incorporated into an overall Structured Assessment Approach (SAA) being developed at the Laboratory.[1,2,3,4] Vulnerability analysis of material control and accounting systems at a nuclear processing facility has been performed through the application of

Petri Nets and the SAA.[1] The Petri Net is viewed as a potentially powerful tool in the design of adequate safeguard systems.

79-28 A CONCEPT FOR THE EVALUATION OF SAFEGUARD PROCEDURES
UCRL-82419, February 28, 1979
Presented at the INMM Conference,
Albuquerque, NM, July 16-19, 1979

J. D. Salisbury
J. W. Savage

Abstract

This report describes a methodology for the evaluation of safeguards procedures. As presently conceptualized, the methodology will consist of the following steps:

1. Expansion of the general protection requirements that are contained in the NRC regulations into more detailed but still generic requirements for use at the working level.

2. Development of techniques and formats for using the working-level requirements in an evaluation.

3. Development of a technique for converting specific facility protection procedures into a format that will allow comparison with the working-level requirements.

4. Development of an evaluation technique for comparing the facility protection procedures to determine if they meet the protection requirements.

79-29 TOOLS FOR ASSESSING AND DESIGNING MATERIAL CONTROL PROCESSING MONITORS
UCRL-82420, February 28, 1979
Presented at the INMM Conference,
Albuquerque, NM, July 16-19, 1979

D. R. Dunn
J. V. Candy
R. B. Rozsa

Abstract

This paper reviews some of the computational tools developed by Lawrence Livermore Laboratory (LLL) for the assessment and design of Material Control and Accounting (MC&A) process monitoring components and illustrates their application to a Pu evaporator/concentrator unit operation.

The codes which we have developed include: (1) a general-purpose dynamic simulator for modeling the physical phenomenology of various chemical unit operations and their associated measurement systems, (2) an estimation code for simulating the operation of some modern signal processing algorithms (Kalman filter formulation), and (3) a set of detection algorithms for simulating on-line material loss detection algorithms for simulating on-line

material loss detection. These codes can be used to address the issues of on-line material accounting and diversion detection for safeguarding SNM, and specifically with respect to arriving at meaningful performance measures. They can be used to compare state-of-the-art with state-of-the-art practice and to study cost benefit trade-offs. They are capable of treating stochastic models with nonlinear process and measurement dynamics and as a result should provide means for better designs of MC&A process monitoring components.

79-30   ADVERSARY TAMPERING OF ACCOUNTS AND RECORDS IN   J. J. Lim
         A MATERIAL ACCOUNTING SYSTEM TO DISGUISE A SNM   J. G. Huebel
         THEFT
         UCRL-82421, February 28, 1979
         Presented at the INMM Conference,
         Albuquerque, NM, July 16-19, 1979

Abstract

A typical nuclear materials accounting system employing double-entry bookkeeping is described. A directed graph, or logic diagram, is used to model the interactions of the accounting system and the adversary when he attempts to thwart it. Boolean equations are derived from the graph; solution of the equations yields the combinations of ways in which the adversary may disguise a SNM theft via the accounting system and the collusion requirements needed to accomplish this feat.

79-31   A SAFEGUARD SYSTEM VULNERABILITY ANALYSIS   G. M. Gilman
         METHODOLOGY   M. H. Dittmore
         Presented at the INMM Conference,
         Albuquerque, NM, July 16-19, 1979

Abstract

This paper presents a step-by-step procedure for determining safeguard system vulnerabilities. The Safeguard System Vulnerability Analysis Methodology (SSVAM) uses graphical techniques to model safeguard systems at nuclear facilities. The system Boolean equations are written from the graphs and the adversary event sets calculated from the system equations. Using SSVAM both hardware systems and nonhardware systems (such as material control and accounting systems) can be successfully modeled and analyzed.

79-32   DYNEST - A DYNAMIC ESTIMATOR CALCULATION   R. N. Castleton
         PROGRAM   J. V. Candy
         UCRL-52573, February 1979

Abstract

This report describes the implementation and usage of the computer

program DYNEST. This Fortran IV code was designed to implement three sophisticated on-line state estimation algorithms: the extended, iterated, and linearized Kalman filters. The algorithms are employed to obtain state and parameter estimates of nonlinear or linear dynamic system and discrete measurement models.

Various features of the DYNEST code and its structure are presented. The preparation of user-supplied subroutines for a simple nonlinear estimation problem is discussed, along with the actual implementation and running of this code. Sample runs of each algorithm are discussed, along with the code outputs.

In the appendices the implementation of the linear Kalman filter as a special case of the extended filter is discussed. The application of the algorithm to calculate Cramer-Rao bound and a nonlinear parameter estimation (simultaneous state and parameter estimation) is presented. Various flow charts and error messages are discussed.

This code represents a first-generation implementation of sophisticated state estimation algorithms; however, much improvement and expansion are possible. A statistical analysis package consisting of sample statistical tests should be developed in determining if the algorithms are operating properly. Some of these simple tests are included in the code; however, more sophisticated techniques should be developed.

79-33   COMPUTATIONAL TOOLS FOR MATERIAL CONTROL   D. R. Dunn
        ASSESSMENT AND DESIGN OF PROCESSING MONITORS: J. V. Candy
        AN OVERVIEW   J. G. Huebel
        UCRL-52702, February 1979

Abstract

This report reviews several computer codes (DYNSYL, DYNEST, and DDET) that have application in the assessment and design of Material Control and Accounting (MC&A) process monitor components. The report emphasizes that the tools and procedures required for performance modeling are also applicable to the design of safeguard process monitors.

79-34   RAILGUNS AND THEIR RELATIONSHIP TO MEGA GAUSS   R. S. Hawke
        FIELDS   J. K. Scudder
        UCRL-82104, February 1979

Abstract

Recent research[1] has revived interest in electromagnetic rail guns, which utilize the lorentz force to accelerate a plasma, which in turn accelerates a dielectric projectile. Calculations have indicated that it is possible, with present technology, to accelerate a 10g projectile to velocities in excess of 20 km/s.

Applications will be discussed and data on preliminary experiments will be presented.

79-35   TRANSIENT DIAGNOSTICS INSTRUMENTATION NEWSLETTER   C. McConaghy,
         FOR THE DOE COMMUNITY   Editor
         USP-1, March 1, 1979

Abstract

This is the second edition of the TDI Newsletter. It covers transient recording, solid state devices for transient recording, and fast optical techniques being worked on at DOE labs. The contributors to this edition of the newsletter are from Sandia, EG&G, LLL, LBL, LASL, Fermi Labs and Brookhaven Labs.

79-36   SPACE-CHARGE-LIMITED CURRENT IN Cu_xS/CdS L. D. Partain
         SOLAR CELLS   G. A. Armantrout
         UCRL-82432, March 5, 1979   J. Leong
         Presented at the Electronic Materials
         Conference, Univ. of Colorado, Bolder, CO,
         June 27-29, 1979

Abstract

The current-voltage (I-V) characteristics of Cu_xS/CdS solar cells have long provided unusual properties that have been difficult to explain theoretically. These properties include a temperature independent slope of the I-V curves, a cross-over of the dark and light I-V curves, a soft breakdown reverse bias characteristic that does not saturate, an evolution of I-V with heat treatment from near Ohmic to rectifying, and high forward voltage drops in the dark. The I-V properties of Cu_xS/CdS heterojunctions formed on substrates of polycrystalline, thin film CdS and on single crystal CdS were measured as a function of temperature between liquid nitrogen and room temperature and as a function of $180°$ C heat treatment in a hydrogen-argon gas ambient for light exposed and dark conditions. When this data was plotted as log $(I + I_{sc})$ versus log (V) (where I is the short circuit current equal to zero in the dark), it was well fit by straight line segments proportional to V, V^2, V^m (m>2), V^2 respectively for increasing forward voltages. This dependence is well known to be characteristic of space-charge-limited (SCL) current and is identical to that widely reported for SCL currents in thin film, polycrystalline CdS to which Ohmic and Schottky barrier contacts had been attached. In agreement with the above Schottky barrier, SCL devices; our reverse bias data showed rectification with soft breakdown and no current saturation. The data maintained the same power law dependence on V to maintain a temperature independent slope but with a current amplitude (at a given voltage) that increased with T as expected theoretically as a reported widely for SCL current in CdS. Modeling the SCL behavior as being caused by thermal diffusion of Cu traps from the Cu_xS into the CdS a

distance determined by the zero bias capacitance of the device gave
I-V characteristics that consistently fit the dark-light I-V
cross-over, the evolution of the I-V with heat treatment, the high
forward V drop in the dark, and the temperature dependence for
equilibrium hole concentrations (in the electron traps) in the
10^{13}-10^{14} cm^{-3} range. Such trapped hole concentrations agree
with the workers of other workers for SCL current in CdS.

79-37   QUADRANTAL SYMMETRY CONDITIONS FOR NONSYMMETRIC   D. M. Goodman
HALF-PLANE FILTERS
UCRL-82443, March 7, 1979
Submitted for publication in the IEEE Trans.
on Circuits and Systems

Abstract

The conditions under which a nonsymmetric half-plane filter has a
quandrantally-symmetric magnitude response are investigated.
Necessary and sufficient conditions are stated for both the
numerator and the denominator of the filter transfer function.

79-38   EVALUATION OF SAFEGUARDS PROCEDURES: J. D. Salisbury
A SUMMARY OF A METHODOLOGY   J. W. Savage
UCID-18109, March 8, 1979

Abstract

This report describes a methodology for the evaluation of
safeguards procedures. As presently conceptualized, the
methodology will consist of the following steps.

1. Expansion of the general protection requirements that are
   contained in the NRC regulations into more detailed but still
   generic requirements for use at the working level.

2. Development of techniques and formats for using the
   working-level requirements in an evaluation.

3. Development of a technique for converting specific facility
   protection procedures into a format that will allow comparison
   with the working-level requirments.

4. Development of an evaluation technique for comparing the
   facility protection procedures to determine if they meet the
   protection requirements.

79-39   DEFINITION OF SUBSURFACE FEATURES BY GEOPHYSICAL   R. J. Lytle
PROBING
UCRL-81307, March 9, 1979
Presented at the Symposium on Special Topics
in HF Propagation, Lisbon, Portugal,
May 28 - June 1, 1979

Abstract

This report provides an overview of recent advances in near surface geophysical probing. Work progresses in four areas. One of these areas is fundamental studies, which involves not only mathematical studies but also laboratory and controlled in-situ experiments. Empirical curves can be generated that relate remotely sensed observable to the parameters important for construction or other near surface applications. Another area is instruments development. For a sensing method to be effective and routinely used, the functioning device must be quick, easy, and cheap to use in the field. Examples in this report show the recent instrumentation development results. Data processing development is another progressing area, particularly for the field environment. Another area is data interpretation. Once the instrument system is functioning and empirical curves have been generated in fundamental studies, the capability exists to interpret the data. Data interpretation uses all the known information that applies to the site. Advances in systematic ways of routinely analyzing this data are presented.

79-40   A STUDY OF TARGET IDENTIFICATION USING POLES   E. K. Miller
        UCRL-52685, March 15, 1979

Abstract

Three techniques for identifying radar targets by using their electromagnetic resonances or poles are studied. A singular advantage of such a pole-based approach is that it can operate independently of the target excitation. A library of pole sets is used both to generate the target waveforms (to which noise is added) and to correlate with parameters extracted from those waveforms. The techniques studied are linear prediction, residue calculation, and pole calculation. Direct waveform correlation was also evaluated for comparison with the pole-based techniques. Using 10-run-average correlation values, error-free identification was accomplished by pole calculation at a peak-signal-to-peak-noise ratio as low as 10, and by waveform correlation at a noise ratio of unity.

79-41   ARRAY PROCESSOR IMPLEMENTATION OF 2-D DIGITAL   R. E. Twogood
        FILTERS
        UCRL-82472, March 15, 1979
        Presented at the 1979 IEEE Int. Symp. on Circuits
        and Systems, Tokyo, Japan, July 17-19, 1979

Abstract

The recent introduction of array processors for fast scientific computation has had an important impact on the field of digital signal processing. This paper investigates the potential application of the array processor (AP) to the implementation of

2-D finite impulse response (FIR) digital filters via the 2-D FFT algorithm. Both CPU and I/O effects are discussed, and architecture considerations such as the amount of memory available in the AP are analyzed with respect to their impact on the filtering algorithm.

79-42   CROSS-BOREHOLE GEOPHYSICAL PROBING FOR SITE   R. J. Lytle
CHARACTERIZATION
UCRL-81901, March 16, 1979
Presented at the 1979 Rapid Excavation and
Tunneling Conference, Atlanta, GA,
June 18-21, 1979

Abstract

An overview of electromagnetic geophysical probing methods used for high, moderate, and low contrast situations is described. Sample theoretical and experimental results are given. The utility of the discussed procedures for more general applications is presented.

79-43   DIGITAL, REALIZABLE WIENER FILTERING IN   M. P. Ekstrom
TWO-DIMENSIONS
UCRL-82504, March 16, 1979
Presented at the 1979 Int'l Symp. on
Mathematical Theory for Networks and Systems,
Delft, Holland, July 3-6, 1979

Abstract

This paper deals with the extension of Wiener's classical mean-square filtering theory to the estimation of two-dimensional (2-D), discrete random fields. In analogy with the 1-D case, the optimal realizable filter is derived by solution of a 2-D discrete Wiener-Hopf equation using a spectral factorization procedure. Computational algorithms for performing the required calculations are discussed.

79-44   STATISTICAL FAILURE ANALYSIS OF MILITARY   H. S. Cabayan
SYSTEMS FOR HIGH-ALTITUDE EMP   F. J. Deadrick
UCRL-82499, March 20, 1979   L. C. Martin
Presented at the Electrical   R. W. Mensing
Overstress/Electrostatic Discharge Symp.,
Denver, CO, IITRI-Reliability Analysis Center,
September 25-27, 1979

Abstract

A probabilistic approach to vulnerability assessment that allows inclusion of uncertainties into the analysis is outlined and discussed. The approach is illustrated and validated to a limited extent by two simple system experiments that included device failure data, circuit analyses, failure analyses, and separate

laboratory system tests with a transient electromagnetic facility. The computer programs NET-2 and FAST were essential tools in the analyses.

79-45   POLE EXTRACTION FROM REAL-FREQUENCY INFORMATION   J. N. Brittingham
         UCRL-80028, Rev. 1, March 29, 1979   E. K. Miller
         Published in the Proc. of IEEE,   J. L. Willows
         February 1980

Abstract

This paper describes a procedure, analogous to Prony's method, for extracting the complex-frequency poles of electromagnetic transfer functions. The method is refined mathematically and is applied to both electrical and mechanical test cases. The paper explains a multiple processing technique, involving the overlaying of several pole sets, by which redundant data are used to separate actual from curve-fitting poles. Identification of an unknown target by comparing its scattered field with the pole sets of known targets is also illustrated for simple targets.

79-46   NONLINEAR ESTIMATION OF A COMPLEX CHEMICAL   J. V. Candy
         PROCESS USING THE LINEARIZED KALMAN FILTER
         UCIR-1295, March 1979
         (Not available offsite)

Abstract

This report briefly develops the linearized Kalman filter in tutorial fashion. It shows that the linearized filter can replace the extended Kalman filter in some cases without serious degradation of performance. Both filters are used to implement an on-line diversion detector. Simulation results for high signal-to-ratios are discussed.

79-47   DESIGN TECHNIQUES FOR LARGE SCALE LINEAR   J. V. Candy
         MEASUREMENT SYSTEMS
         UCID-18116, March 1979

Abstract

In this report we primarily discuss some techniques to design measurement schemes for systems modeled by large scale linear time invariant systems, i.e., physical systems modeled by a large number (>5) of ordinary differential equations. The techniques are based on transforming the physical system model to a coordinate system facilitating the design and then transforming back to the original coordinates. An example of a three-stage, four-species, extraction column used in the reprocessing of spent nuclear fuel elements is presented.

The basic ideas are briefly discussed in the case of noisy measurements. An example using a plutonium nitrate storage vessel (reprocessing) with measurement uncertainty is also presented.

79-48   PROCESS MONITOR DESIGN FOR AN EXTRACTION   J. V. Candy
       COLUMN - AN APPLICATION OF ESTIMATION/DETECTION   R. A. Emmert
         UCID-18128, March 1979   G. K. Patterson

Abstract

The NRC Safeguards Program at LLL is directed toward developing a methodology for assessing the effectiveness of material control and accounting systems at processing/reprocessing facilities for special nuclear material. The methodology under development requires many types of mathematical models including performance models of safeguard components. Included in the class of safeguard components are real-time measurement systems which incorporate on-line estimators/detectors for the timely detection of material losses.

Performance modeling generally involves mathematical model development and simulation of the physical process being measured. This report discusses the development of material estimator designs for a liquid-liquid extraction column using a reprocessing application. These designs are applicable to any processing unit which can be adequately represented by linear or nonlinear models in state space form. Although this work is discussed in the context of a plutonium extraction column, it is representative of two classes of safeguard components which are generic to any fuel cycle involving chemical separations/purifications.

79-49   SAFEGUARDS MATERIAL CONTROL AND ACCOUNTING   D. R. Dunn
       PROGRAM: QUARTERLY REPORT, JANUARY-MARCH, 1979
         UCRL-52715, March 1979

Abstract

We summarize activity for the quarter January through March 1979 in the Material Control Safeguards Evaluation Program, conducted for the U.S. Nuclear Regulatory Commission (NRC) at Lawrence Livermore Laboratory. The computer-assisted methodology for the assessment of Material Control and Accounting (MC&A) systems was completed. Work continues on the full automation and improvement of the System Vulnerability Analysis Methodology (SVAM) and the Structured Assessment Approach (SAA), an alternate, more automated methodology. Current work on the development of assessment methodologies is summarized. Monitor characterization work done in support of the assessment methodologies is described. Work continued in assisting the NRC to develop the MC&A upgrade rule. Other areas of activity are aggregated systems model development and adversary modeling. The DYNSYL chemical simulation code and subroutines have been improved and are discussed, as well as the

application of signal processing techniques to measure material loss in the nuclear industry.

79-50   MODELING ADVERSARY ACTIONS AGAINST A NUCLEAR   J. J. Lim
MATERIAL ACCOUNTING SYSTEM   J. G. Huebel
UCRL-81949, April 1, 1979
Presented at the ESARDA 1st Annual
Symposium, Brussels, April 25-27, 1979

Abstract

A typical nuclear material accounting system employing double-entry bookkeeping is described. A logic diagram is used to model the interactions of the accounting system and the adversary when he attempts to thwart it. Boolean equations are derived from the logic diagram; solution of these equations yields the accounts and records through which the adversary may disguise a SSNM theft and the collusion requirements needed to accomplish this feat. Some technical highlights of the logic diagram are also discussed.

79-51   ON-LINE SAFEGUARDS DESIGN: AN APPLICATION OF   J. V. Candy
ESTIMATION/DETECTION   D. R. Dunn
UCRL-82210, April 1, 1979   R. B. Rozsa
Presented at the First ESARDA Symposium,
Brussels, Belgium, April 24-27, 1979

Abstract

The applicability of modern signal processing techniques to the safeguards problem for a plutonium nitrate storage tank and concentrator is addressed. The techniques involve mathematical modeling, optimal estimation of process variables, and the detection of abnormal changes in these variables due to adversary diversion. The performance of these techniques is presented for various diversion scenarios.

79-52   A NEW SERIES REPRESENTATION FOR THE   J. N. Brittingham
TWO-DIMENSIONAL SOMMERFELD INTEGRALS
UCRL-80062, Rev. 2, April 9, 1979
To be published in Radio Science

Abstract

This paper presents an absolutely convergent series representation for two Sommerfeld integrals needed in writing the electrical fields for the case of a transmission-line current source on an interface when both the source and the point of interest are on the interface. The series is evaluated in terms of Hankel functions. Some numerical results are given to demonstrate the rapid convergence of the series.

79-53   UNCERTAINTIES IN HARDNESS SPECIFICATION   R. M. Bevensee
         UCRL-82600, Abstract and Summary only,   H. S. Cabayan
         April 16, 1979   F. J. Deadrick
         Presented at the System EMP Hardening   L. C. Martin
         Symp., Naval Ocean Systems Center,   R. W. Mensing
         San Diego, CA, DNA, August 7-9, 1979

Abstract

The specification of protection requires at the minimum an
approximate knowledge of the environment and some measure of its
effect on the system. In practice one must go further.
Uncertainties exist in statements of the environment, particularly
as this environment couples to and propagates through the system.
Similarly, there are basic susceptibilities of the components,
units, and subsystems which are subjected to these uncertain
environments. These, too, are subject to variation and are not
always very well known.

This paper reviews briefly some of the identified uncertainties
which will be present in many of the present DOD systems hardening
problems. The specification of hardness indeed requires that these
uncertainties be considered in some manner. This paper also
suggests and outlines in some detail an approach which can deal
with the problem of uncertainties in an assessment of the system
for hardness specification.

79-54   UNCERTAINTIES IN WEAPON GAMMA OUTPUT AND EMP   H. S. Cabayan
         UCRL-82599, Abstract only, April 16, 1979
         Presented at the System EMP Hardening Symp.,
         NOSC, San Diego, CA, DNA, August 7-9, 1979

Abstract

This paper describes the ranges of expected gamma outputs from
several types of weapons and the resulting ranges of EMP outputs.
In addition, the issues of uncertainties inherent in evaluating
gamma outputs will be addressed by presenting test data and
computations performed by personnel at Lawrence Livermore
Laboratory covering the period from 1967 to 1978. Issues related
to EMP output from Foreign Weapons will also be addressed.

79-55   OBTAINING ACCURATE VALUES OF DIFFUSION   L. D. Partain
         LENGTH WITH THE SCANNING ELECTRON MICROSCOPE   S. P. Shea
         UCRL-82617, April 18, 1979
         Presented at the 1979 Photovoltaic Solar
         Energy Conference, Berlin, Germany,
         April, 1979

Abstract

The slope of data plots of the logarithm of electron-beam-

induced-current (EBIC) versus beam position directly specify the minority carrier diffusion length (L) for the special case where the beam-induced generation volume can be considered a point source many diffusion lengths away from external surfaces of a planar sample. Restricting the acceleration voltages (E_0) so that the Gruen range (R_G) is less than four times the diffusion length being measured allows the generation volume to be considered a point source as far as the influences of the surface parallel to the junction and the intersection of the junction with the generation volume are concerned if the thickness of the measured region is greater than or equal to 2L. Consideration of the surface perpendicular to the junction indicates the E_0 should be further restricted so that $R_G \leq 0.84L$. This allows L values to be determined to within 15% simultaneously with recombination velocity values (V_F) normalized by the diffusion constant (D) to within 20% by curve fitting semilogarithmic EBIC data. This gave $L(Cu_2S) = 0.25\,\mu m$, $L(CdS) = 0.04\,\mu m$, $V_R/D\ (Cu_2S) = 4(10^4)/cm$ and $V_R/D(CdS) = 5(10^4)/cm$ for a Cu_2S/CdS heterojunction. Two tellurium doped GaAs Schottky barrier samples had L values of 3.0 and 6.0 microns with a single V_R/D value of $3.3\ (10^4)/cm$.

79-56   ANALYSIS OF THE PERFORMANCE CAPABILITY OF   D. R. Dunn
AN INFRARED INTERIOR INTRUSION DETECTOR
UCID-18115, April 19, 1979

Abstract

Component performances are required by the LLL assessment procedure for material control and accounting (MC&A) systems. Monitors are an example of an MC&A component whose functions are to process measurements or observations for purposes of detecting abnormalities.

This report develops a methodology for characterizing the performance of a class of infrared (IR) interior intrusion monitors or detectors. The methodology is developed around a specific commercial IR detector, the InfrAlarm, manufactured by Barnes Engineering Company (Models 19-124 and 19-115A). Statistical detection models for computing probabilities of detection and false alarms were derived, and the performance capability of the InfrAlarm IR detector was shown using these measures. The results obtained in the performance analysis show that the detection capability of the InfrAlarm is excellent ($\sim$1), with very low false alarm rates, for a wide range in target characteristics. These results should be representative and particularly for non-hostile environments.

79-57   AlSb AS A POTENTIAL PHOTOVOLTAIC ENERGY   G. A. Armantrout
CONVERTER   J. H. Yee
UCRL-81982, April 19, 1979
Presented at the 1979 Photovoltaic Solar
Energy Conference, Berlin, Germany,
June, 1979

Abstract

AlSb is of interest as a terrestrial photovoltaic material due to the relative abundance and low cost of its constituents and also due to the high conversion efficiency demonstrated by the other III-V semi-conductors, GaAs and InP. AlSb can be doped both n and p type thereby making homojunction formation possible. We have theoretically studied the performance at AM1 of an AlSb homojunction device using published and calculated values of the important cell parameters. We have found the $\eta \leqslant 13\%$ for AlSb cells under realistic cell conditions and that such cells show a steady drop in efficiency for monority carrier life-times $<10^{-6}$ seconds. Since AlSb departs thermodynamically from stoichiometry due to Sb vacancy formation during growth, current Czochralski crystals will yield cells with $\eta<8\%$ efficiency with values of $\eta<2\%$ being more likely. Alternative growth techniques will be necessary to produce higher effiency cells.

Preliminary measurements of Schottky barrier cells made from Lawrence Livermore Laboratory Czochralski grown AlSb crystals have yielded cells with J_{sc} = 1.2 ma/cm^2 and V_{oc} = 66 mV. Barrier heights of 0.4 - 0.6 eV have been measured for ITO contacts. The low observed value of J_{sc} is likely due to the short bulk lifetime in the material being used.

79-58   FABRICATION OF LASER TARGET COMPONENTS BY   W. E. Tindall
         SEMICONDUCTOR TECHNOLOGY
         UCRL-82644, April 23, 1979
         Submitted for publication in American
         Vacuum Society

Abstract

This paper describes the design and fabrication of a unique silicon substrate with which laser target components can be mass produced. Different sizes and shapes of gold foils from 50 to 3000 microns in diameter and up to 25 microns thick have been produced with this process since 1976.

79-59   ELECTROMAGNETIC BURNFRONT MAPPING DURING   D. T. Davis
         A.R.CO.'s 1978 IN SITU COAL GASIFICATION PROJECT E. F. Laine
         UCRL-52772, April 30, 1979   R. J. Lytle
                                                           J. T. Okada

Abstract

High-frequency electromagnetic (HFEM) probing was used to map the position of the burnfront in an underground coal gasification experiment conducted by the Atlantic Richfield Company at Rocky Hill, Wyoming. The coal seam in this experiment was 110 ft thick and approximately 700 ft deep, thicker and deeper than the seam probed during a previous gasification experiment at Hoe Creek,

Wyoming. Also, the gasification was over a wider area than at Hoe Creek. These different conditions allowed new techniques of HFEM probing to be tried. The authors used lower frequencies to reduce signal attenuations that resulted from the longer cables needed to reach the seam depth and from the longer probing distances. In spite of the low frequencies, the probing results showed good spatial resolution. The greater thickness of the seam allowed a better test of the HFEM lateral-position determination, and this determination also showed good spatial resolution. Other observations of the HFEM technique were consistent with findings from the Hoe Creek experiment.

79-60   SIMPLIFIED GROUND WATER CONTAMINANT TRANSPORT   K. D. Pimental
         MODELING: AN APPLICATION OF KALMAN FILTER   J. V. Candy
         BASED IDENTIFICATION   D. R. Dunn
             UCRL-82649, April 30, 1979
             Presented at the IFIP Working Conference on
             Simulation and Environment, Gwyneeld,
             Wales

Abstract

In order to enable computationally feasible risk assessments for long term nuclear waste repositories, the need exists for simplified or reduced-order models of groundwater containment transport. These models will be used in Monte Carlo simulations to generate probabilities of nuclear waste migration in aquifiers during the design and location of waste storage sites in the United States.

This paper presents a feasibility study using Kalman-filter based estimator/identifiers to realize reduced-order ground-water transport models from simulated measurement data. A large-scale numerical simulation model is used as the "truth" model to supply simulated pressure-head measurements for analysis. A candidate reduced model to be identified is implemented in the algorithms. Modeling error statistics are provided for the parameter estimates indicating the individual algorithm performance. The identified model performance is then compared to the "truth" model to ascertain its adequacy.

79-61   ON-LINE ESTIMATOR/DETECTOR DESIGN FOR A   J. V. Candy
         PLUTONIUM NITRATE CONCENTRATOR UNIT   R. B. Rozsa
             UCID-18124, April 1979

Abstract

In this report we consider the design of a nonlinear estimator to be used in conjunction with on-line detectors for a plutonium/concentrator. Using a complex state-of-the-art process model to simulate "realistic" data, we show that the estimator performance using a simplified process model is adequate over a

wide range of operation.

The estimator is used to simulate and characterize some on-line diversion detectors, i.e., detectors designed to indicate if some of the critical special nuclear material in process is stolen or diverted from the unit. Several different diversion scenarios are presented. Simulation results indicate that the estimators and detectors yielded reasonable performance for the scenarios investigated.

79-62 ENERGY AND TECHNOLOGY REVIEW - "DIGITAL IMAGE   R. E. Twogood
       PROCESSING AT LLL"
       UCRL-52000-79-4, April 1979

Abstract

Digital image processing has become a widely applied diagnostic tool since its initial application in the nation's space program. It is used today in such varied applications as processing data from satellites that monitor environmental phenomena, earth resources, and urban land use; processing geological and seismological data in oil and natural gas exploration; creating three-dimensional images of the human brain with multiple two-dimensional projection techniques; and processing medical and industrial radiographs.

Several years ago, we developed an image-processing facility to process and display two-dimensional data from our energy and weapons programs. This facility included an interface to the Laboratory's computer network, which enabled us to use complex processing algorithms for large data arrays, along with considerable user-machine interaction, which added flexibility to processing schemes.[1,2] Since then, we have upgraded both the hardware and software of our image-processing facility.

79-63 PARAMETRIC CHARACTERIZATION OF THE ELECTRO-   W. D. Smith
       ENCEPHALOGRAM FOR SURGERY MONITORING   D. L. Lager
       UCRL-81697, April 1979
       Presented at the AAMI, Las Vegas, NV,
       May 22, 1979

Abstract

A parametric characterization of the electroencephalogram suitable for real time processing is applied to human surgery EEGs. Five or fewer parameters, versus the 50-100 in a typical spectral density, adequately describes the patient's EEG state.

79-64 AN APPROACH TO EVALUATING AND IMPLEMENTING   H. S. Cabayan
       EMP PROTECTION REQUIREMENTS FOR COMMUNICATION   F. J. Deadrick
       CENTERS   L. C. Martin
       UCRL-52771, May 1, 1979

Abstract

We examine the problem of protecting communication centers against the threat of high-altitude nuclear electromagnetic pulses (EMP). Because such EMP could damage components in an unprotected facility, we describe an approach to develop a set of minimum requirements so that effective hardening procedures can be designed and implemented. Our approach includes evaluation of currently recommended protection practices, cost analyses, and development of test requirements, plans, and facilities.

79-65   DEVICES FOR LAUNCHING 0.1-g PROJECTILES TO   J. N. Brittingham
        150 km/s OR MORE TO INITIATE FUSION: PART 1,
        MAGNETIC-GRADIENT AND ELECTROSTATIC ACCELERATORS
        UCRL-52778, May 1, 1979

Abstract

I studied the feasibility of using magnetic-gradient and electrostatic accelerators to launch a 0.1-g projectile to hypervelocities (150 km/s or more). Such hypervelocity projectiles could be used to ignite deuterium-tritium fuel pellets in a fusion reactor. For the magnetic-gradient accelerator, I explored several types of projectile: shielded and unshielded copper, ferromagnetic, and superconducting. My calculations revealed the superconducting projectile to be the best of those materials I studied. It would require a 3.2-km-long magnetic-gradient accelerator and achieve a 92% efficiency. Of the cases I studied, this accelerator-projectile combination would be the one most likely to launch a 0.1-g projectile to 150 km/s or more. Its components would cost $58.9 million. I found the electrostatic accelerator to be impractical because of its excessive length of 23 km.

79-66   ON-LINE STRUCTURAL RESPONSE ANALYSIS: USING   J. V. Candy
        THE EXTENDED KALMAN ESTIMATOR/IDENTIFIER
        UCID-18175, May 5, 1979

Abstract

This report discusses the development of on-line state and parameter estimators used to analyze the structural response of buildings. The estimator/identifier is an extended Kalman filter (EKF), which has been applied with great success in other technological areas. It is shown that the EKF can perform quite well on simulated noisy structural response data.

79-67   DESIGN AND ANALYSIS OF ISENTROPIC COMPRESSION   R. S.Hawke
        EXPERIMENTS
            UCRL-81797, May 7, 1979
            Presented at the 2nd Int'l Conf. on
            Megagauss Field Generation and Related
            Topics, Rosslyn, VA, May 29-June 1, 1979

Abstract

This paper briefly summarizes the magnetic flux compression to isentropically compress matter. Details of the process used to extract boundary data from the flash radiographs and the design criteria for the containment of very compressible material are discussed. Finally, suggestions for improvement of the next generation of experiments are made.

79-68   MAGNETIC PROPULSION RAILGUNS: THEIR DESIGN   R. S. Hawke
        AND CAPABILITIES   J. K. Scudder
          UCRL-82677, May 8, 1979

Abstract

Recent research has revived interest in electromagnetic railguns. A railgun utilizes the Lorentz force to accelerate an electrically conducting armature, which in turn accelerates a projectile. Our investigation identified the critical parameter that will lead to limits on railgun operation. These limits were incorporated in calculations of the performance of railguns. The calculations indicate that it is possible with present technology to accelerate a projectile to velocities in excess of 20 km/s.

79-69   THE SYSTEMATIC COMPUTATION OF THE PERFORMANCE   J. H. Yee
        OF PHOTOVOLTAIC CELLS BASED ON FIRST PRINCIPLES   G. J. Burke
          UCID-18041-4, May 15, 1979   R. G. Harvey

Abstract

The optical absorption coefficient for the ternary compounds $CdSiAs_2$ and $CuInSe_2$ have been calculated theoretically, based upon the pseudopotential technique and reflectivity data. The experimental absorption coefficient of $CuInSe_2$ agrees very well with the calculated absorption coefficient. Computer simuluation was carried out for a CdS-$CuInSe_2$ heterjunction solar cell. The theoretical results compare favorably with the experimental result.

Derivation of an expression for the minority-carrier diffusion length in $CuInSe_2$ together with some numerical results for the diffusion length are presented. The Schottky barrier height for Cu_2O has been calculated and the independence of the barrier height on the work function of the metals explained. A model explaining the unconventional behavior of indium doped CdS is presented. The model involves the formation of indium clusters causing conduction band distortions.

79-70   IMPLEMENTATION STUDY FOR THE NRC APPLICATION   R. J. Sherwood
        AND DEVELOPMENT FACILITY   D. J. Ross
          UCRL-52713, May 15, 1979   D. W. Sasser

Abstract

The Nuclear Regulatory Commission (NRC) has expressed the desire to establish an Application and Development Facility (ADF) for NRC Headquarters. The ADF is a computer system which will provide safeguards analysts access to safeguards analysis computer software. This report analyzes the issues, requirements and options available in the establishment of an ADF.

The purposes and goals of the ADF are presented, along with some general issues to be considered in the implementation of such a system. A phased approach for ADF implementation, which will allow for the earliest possible access to existing codes and also allow for future expansion, is outlines. Several options for central computers are discussed, along with the characteristics and approximate costs for each. The report concludes with recommended actions proposed to start the development of the ADF.

79-71   TOWARDS UNIFIED PERFORMANCE MEASURES FOR   G. C. Corynen
EVALUATING NUCLEAR SAFEGUARD SYSTEMS:
MATHEMATICAL FOUNDATIONS AND FORMAL COMPARISON
OF EXISTING MODELS
UCRL-52793, May 15, 1979

Abstract

An important step in the analysis of large-scale systems is the development of economical and meaningful measures of system performance. In the literature on analysis of nuclear safeguard systems, many performance measures have been advanced, but their interrelationships and their relevance to overall system objectives have not received attention commensurate with the effort spent in developing detailed safeguard models. The work reported here is an attempt to improve the development and evaluation of performance measures for nuclear safeguard systems. This work falls into three main areas. First, we develop a new framework which provides an initial basis for defining and structuring performance measure. To demonstrate that this framework allows a clear understanding of the purposes of nuclear safeguard systems, we employ it to state various safeguard questions clearly and concisely. The framework reflects the rough subsystem structure of safeguard systems - the detection and response subsystems - and formally accommodates various safeguard models. We especially emphasize two of these models which are under development at Lawrence Livermore Laboratory, the structured assessment approach (SAA) and the systems vulnerability assessment method (SVAM). Second, we examine some performance measures presently used in the nuclear safeguards area and in reliability theory in general. Some of these we accept and modify to obtain system performance measures that are an additive combination of subsystem performance measures, a very convenient form indeed. Others we reject as impractical and meaningless. Finally, we determine some common features between

the SAA and SVAM models by formally comparing these models in our framework.

79-72   PROPERTIES OF THE GROUND INFERRED FROM   R. J. Lytle
         ELECTROMAGETIC MEASUREMENTS
         UCRL-80851, Rev. 2, May 15, 1979
         Published in the IEEE Trans. on Antennas
         and Propagation, Vol. AP17, No. 6, Nov. 1979
         pp. 899-901

Abstract

This is a mini-review (which is prepared for persons who are unfamiliar with a topic and need a current overview of the art) of the electromagnetic methods of determining the dielectric constant and resistivity of the ground.

79-73   PARAMETRIC CHARACTERIZATION OF RANDOM PROCESSES   W. D. Smith
         USING PRONY'S METHOD   D. L. Lager
         UCRL-52673, May 25, 1979

Abstract

The compact parametric characterization of a random process if often valuable in problems involving signal classification and system identification. The method of Prony suggests two different approaches to obtaining such a characterization from a finite record of sampled data. The first approach is to extract the parameters of the estimated autocorrelation waveform. The second approach is to estimate the parameters of a white noise driven linear system that generates an output with the same characteristics as the given random process.

These two approaches are compared with other common signal processing methods. Also, the performance of each approach is evaluated theoretically and with computer-simulated and experimentally recorded data. Each approach is found to rapidly characterize both stationary and nonstationary random processes. The first approach is superior for the accurate parametric characterization of a stationary process. Alternately, the more precise second approach is best for monitoring changes with time in random process parameters.

79-74   TOWARDS A MATHEMATICAL THEORY OF MODELING   G. D. Corynen
         UCRL-82654, May 1979   S. Aggarwal
         Presented at the Systems Eng. for Power: S. H. Hegner
         US/European Workshop, Davos, Switzerland
         September 30-October 5, 1979

Abstract

An important modeling question which arises in the study of large-scale systems may be roughly expressed as follows. Consider a system s and another system s' whose parts and interconnections model corresponding parts and interconnections of the original system s, to what extent is the whole system s' a model of s?

The answer to this question clearly depends upon what is meant by "model." This paper reports work done on a contract whose principal purpose is to develop a mathematical theory of modeling which is based on a precise definition of the term "model." Two basic definitions have been developed, an abstract definition and a purposeful definition. While the former treats a modeling relation in some "absolute" sense, the latter explicitly accounts for the purposes for which models are developed.

Only the abstract definition is relevant to the report presented here, and only the abstract definition is relevant to the two research areas discussed in this report: System Decomposition, and System Approximation. In the first area, conditions are developed that assume that, if subsystems of a model candidate are models of subsystems of the "real" system, then the candidate is indeed a model of the "real" system as a whole. In the second, we make precise the notion of "approximation", and develop a generalized framework which accommodates approximation concepts as metrics, topologies, uniformities, fuzzy sets, and distributions. In terms of lettices and menoids, a bona-fide generalization of metrics is also obtained.

79-75   A STATISTICAL EVALUATION OF THE PERFORMANCE   D. L. Lager
OF THE TIME-DOMAIN PARET ALGORITHM
UCID-18120, June 1, 1979

Abstract

A methodology was developed for evaluating the performance of the time-domain PARET (TDP) algorithm when processing waveforms contaminated with additive noise. The methodology is general; it may be applied to evaluating the performance of other algorithms and provides a good basis for comparison. The performance is evaluated by computing the bias, veriability, and root mean square error in the parameters estimated by the algorithm when processing ensembles of waveforms. The waveforms used in this study were the displacements as a function of time from a computer simulation (by the SAP IV Program) of an eight-floor structure.

79-76   APPLICATIONS OF PROBABILISTIC POTENTIAL THEORY   R. M. Bevensee
(PPT) TO THE SOLUTIONS OF ELECTROMAGNETIC
PROBLEMS
    UCRL-82760, June 1, 1979
    Submitted for publication in the Journal of
    Computational Physics

Abstract

The analogy between a discretized Laplace-type equation and random walk is indicated. A random walk procedure for evaluating a potential satisfying a Laplace-type or Poisson equation within a closed region is described. Dirichlet, Neumann, and mixed boundary conditions are discussed. We show how PPT may be used to obtain low-frequency solutions for time-harmonic potentials. Applications of PPT are described for the solution of TEM transmission lines, validation of earth conductivity profiles, two-dimensional electromagnetic scattering, surface charge distributions (with the aid of the Green's function), and fields satisfying the vector wave equation within closed regions. Different varieties of PPT computations are described and compared with solutions by Gaussian elimination and finite difference methods on the basis of computing time and storage.

79-77   A METHODOLOGY FOR AIDING NUCLEAR SAFEGUARDS   S. Weissenberger
         DECISION MAKING   B. Judd
            UCRL-82203, June 3, 1979
            Presented at the Am. Nuclear Soc. 1979
            Annual Meeting, Atlanta, GA, June, 1979

Abstract

The regulatory decision on how safe a safeguarded nuclear facility should be depends on a trade-off between diversion risk and the cost of reducing that risk. Given that one plans to build the plant, the optimum level of safeguards is achieved when the cost of further risk reduction exceeds the benefit from lower risk. This paper develops quantitative models of factors which influence this risk/cost trade-off. A basic conceptual structure is presented, and a detailed example is used to illustrate the methodology for optimal regulation setting.

79-78   CONDITIONS FOR TWO-DIMENSIONAL PHYSICAL   M. P. Ekstrom
         REALIZABILITY
            UCRL-82803, June 7, 1979
            Presented at the Asilomar Conf. on Circuits,
            System & Computers, Naval Post Graduate
            School & Univ. of Santa Clara, Pacific
            Grove, CA, November 5-7, 1979

Abstract

This paper deals with the issues of physical realizability and causality as they arise in two-dimensional (2-D) digital signal processing. A canonical model for a 2-D digital signal processor is adopted, which includes a mapping operator, mapping the 2-D data into a 1-D sequence. By incorporating this operator, the classical concept of 1-D causality can be extended directly to the 2-D case. Both spatial and transform domain conditions are developed for

mappings commonly used in applications.

79-79 DESIGN AND IMPLEMENTATION OF HALF-PLANE   S. K. Mitra
        TWO-DIMENSIONAL DIGITAL FILTERS   K. Mondal
          UCRL-82823, June 11, 1979   R. E. Twogood
          Presented at the 1979 Int'l Colloquium on
          Circuits & Systems, Taipei, Taiwan,
          July 24-25, 1979

Abstract

This paper is concerned with the nonsymmetric half-plane (NSHP), recursive, two-dimensional (2-D) digital filters. Such a filter is characterized by a linear shift-invariant (LSI) constant coefficient difference equation that is nonanticipatory in one index but is recursively computable for a fixed direction of recursion. A computer-aided iterative approach is described for the design of a stable, NSHP, 2-D digital filter approximating a specified magnitude response. This approach incorporates a nonlinear optimization procedure to converge to a (locally) optimum half-plane filter while the stability is checked at every iteration using the spectral factorization stability test of Ekstrom and Woods. A novel "penalty function" technique is used to satisfy the stability constraint. Next, the realization of a given NSHP digital transfer function using the basic building blocks (such as delay elements, advance elements, multipliers, and adders) is considered. A general technique which takes into account the restriction of a fixed direction of recursion is described.

79-80 MOVING A D.A. SYSTEM FROM DEVELOPMENT TO   W. G. Magnuson, Jr.
        PRODUCTION
          UCRL-82822, June 13, 1979
          Presented at the 16th DA Conference,
          San Diego, CA, June 25-27, 1979

Abstract

The problems of moving a design automation system from the development phase to the production usage are always numerous, varied, and continuing. Lawrence Livermore Laboratory is a research laboratory, and design automation supports engineering design and fabrication in a slightly different fashion than for a high-volume commercial shop. Jobs are characterized by being quite varied in requirements, requiring fast turnaround, having very low production quantities, having few design constraints, and, in general, place the requirement on the DA system to be both very flexible at the same time as being responsive to requests made on the system by the users.

Yet, the problems of making a DA system production ready in the above situation is probably very similar to the problems encountered in other environments. In the following, I will

describe some of the difficulties we have faced in the past year in moving a printed circuit board layout DA system from a research and development stage to a production usage.

79-81 ARRAY PROCESSOR IMPLEMENTATION OF IMAGE R. E. Twogood
PROCESSING ALGORITHMS
  UCRL-82824, June 13, 1979
  Presented at the ASSP 2-D Workshop,
  Berkeley, CA, October 3-4, 1979

Abstract

Array processor technology is increasingly being applied to applications requiring large amounts of numerical computation. One such area of growing interest is digital image processing. In this presentation, the key issues of image processing in a minicomputer/array processor environment are addressed. These issues include both architecture considerations (amount of memory needed, vector processing throughput, CPU vs. I/O trade-offs, etc.) and the nature of image processing algorithms. Several typical algorithm implementations will be discussed, including the 2-D FFT of externally stored data. A characterization of this architecture is terms of processing speed and cost/performance ratio will also be presented.

79-82 RAILGUN ACCELERATORS FOR LAUNCHING 0.1g PAYLOADS R. S. Hawke
AT VELOCITIES GREATER THAN 150 km/s
  UCRL-82762, June 15, 1979
  Presented at the DOE-sponsored Impact Fusion
  Workshop, Los Alamos, NM, July 10-13, 1979

Abstract

The promise of an abundant energy supply has inspired many approaches to controlling thermal nuclear fusion. One approach to initiating fusion is to use a hypervelocity projectile to impact a deuterium-tritium (DT) pellet. For this purpose, magnetic accelerators have been proposed for accelerating macroparticles to velocities greater than 100 km/s.

This paper summarizes a portion of a study that assesses the feasibility of accelerating a 0.1-g payload to a velocity of 150 km/s or more. In that study it was concluded that magnetic-gradient and railgun accelerators could achieve the goal. In this paper, I discuss the critical factors that limit the design and operation of railgun accelerators and combine these factors with a simulation code to assess potential railgun performance in this regime.

79-83 SPACE-CHARGE-LIMITED CURRENT IN Cu_xS/CdS L. D. Partain
SOLAR CELLS   G. A. Armantrout
  UCRL-82883, June 26, 1979   J. Leong
  Published in the Journal of Electronic   P. Warter
  Materials, Vol. 9, pp. 467-484, May 1980

Abstract

A space-charge-limited current model has been used to consistently and quantitatively model the gross electrical properties of Cu_xS/CdS heterojunctions not explained by standard p-n junction theory. Quantitative fits were obtained for the dark and light crossover of the I-V curves, the evolution of I-V from near Ohmic to rectifying during heat treatment, the high forward voltage drop in the dark, the non-exponential dependence of I on V, and the temperature independent slope of the I-V curves. These were found for CdS trap densities in the 10^{13} to 10^{15} cm^{-3} range, polycrystalline CdS mobilities in the 1 to 10 cm^2/V-sec range, and conduction electron concentrations in the 10^8 to 10^{10} cm^{-3} range in the thin Cu compensated region of CdS produced during cell fabrication heat treatments as monitored by zero bias capacitance. These results imply that entirely different physical mechanisms than those used to described standard p-n junctions control the dark and light I-V characteristics and the conversion efficiency of these solar cells.

79-84   SPACE-CHARGE-LIMITED CURRENT AND CAPACITANCE   R. Moorthy
         IN Cu_xS/CdS HETEROJUNCTION   L. D. Partain
         UCRL-82884, June 26, 1979
         Submitted for publication in the Journal
         of Applied Physics, January, 1980

Abstract

A model based on space-charge-limited (SCL) current has been used to provide the first quantitative explanation for the gross electrical properties of thin film, polycrysalline Cu_xS/CdS heterojunction solar cells which are characterized by non-exponential J-V properties and by cross over of their dark and light J-V curves. Fitting parameter values of $6(10^{14})/cm^3$ trap density located at 0.442 eV below the conduction band in a Cu compensated region of CdS $1.33(10^{-4})$ cm thick for free electron concentrations in the $6(10^9)$ to $2(10^{10})/cm^3$ range and mobilities in the 10 to 30 cm^2/V-sec range are consistent with other reported values SCL current in polycrystalline CdS. A newly developed, transient technique allowed small signal capacitance to be measured in high forward bias near the trap-filled-limit where predicted capacitance variations were found to agree with prior measurements of SCL current in CdS.

79-85   HALL EFFECT IN REACTIVELY SPUTTERED Cu_2S J. Y. Leong
         UCRL-82427, Rev. 1., June 27, 1979   J. H. Yee
         Published in Applied Physics Letters,
         Vol. 35, 39(8), October 15, 1979

Abstract

The Hall effect in thin films of reactively sputtered Cu_2S was measured at temperatures from 90 to 300 K. The hole concentration ranged from 10^{18} to 2×10^{19} cm^{-3}. The hole mobility ranged from 5.5 to 9 $cm^2/V \cdot s$. The predominant scattering mechanisms are ionized impurity scattering at $T < 100$ K and optical phonon scattering at $T > 100$ K.

79-86 HIGH-SPEED RECORDING OF ELECTRICAL TRANSIENTS J. W. Balch
   UCRL-52000-79-6, June 1979   M. D. Pocha
   Published in Energy and Technology   C. F. McConaghy
   Review, LLL, June, 1979

Abstract

Recording short (10^{-8}s) electrical transients is an important diagnostic in weapons development as well as in many energy related testing programs. A new development in solid state electronics - the charge-coupled device (CCD) - may make possible direct digital recording of these short transients at relatively low cost. In the transient-recording instrument, the CCD samples the high-speed analog waveform and temporarily stores it to allow time for subsequent analog-to-digital (A/D) conversion and output.

For the past four years, LLL has been developing special high-speed CCDs for this application. We have constructed laboratory prototypes that can sample transients at a rate of 10^9 analog samples/s. We are currently incorporating these models into prototype transient recorders.

79-87 SAFEGUARDS MATERIAL CONTROL AND ACCOUNTING D. R. Dunn
   PROGRAM: QUARTERLY REPORT, APRIL-JUNE, 1979
   UCRL-52715-79-3, June 1979

Abstract

Activity for the quarter April-June 1979 in the Material Control Safeguards Evaluation Program, conducted for the U.S. Nuclear Regulatory Commission (NRC) at Lawrence Livermore Laboratory, is summarized. Progress was made in developing a computer-based methodology for identifying vulnerabilities in Material Control and Accounting (MC&A) systems in nuclear fuel-cycle facilities. Work was advanced in assisting the NRC in developing the forthcoming MC&A upgrade rule, a redirection of our program since January 1979. Other areas of activity reported on here are aggregated systems model development, adversary modeling, and components performance.

79-88 ON-LINE DIVERSION DETECTION SAFEGUARD CONCEPTS D. R. Dunn
   UCRL-82202, June 1979   J. V. Candy
   Presented at the American Nuclear Society,
   Atlanta, GA, June 14, 1979

Abstract

In this paper, we describe diversion detection concepts for on-line chemical process monitors developed to safeguard special nuclear material (SNM). The concepts involve (a) mathematical modeling of the physical phenomenology for the chemical process and measurement dynamics, (b) optimal estimation of process states, and (c) optimal detection theory.

79-89   DEVICES FOR LAUNCHING 0.1-g PROJECTILES   R. S. Hawke
TO 150 km/s OR MORE TO INITIATE FUSION
UCRL-52778, July 6, 1979

Abstract

I explored the possibility of using a railgun accelerator to launch 0.1-g projectiles to hypervelocities (150 km/s or more) to initiate thermonuclear fusion. My analysis revealed that a railgun with a plasma-arc armature is a viable approach to the goal. When calculating the railgun's probable performance, I discovered that this launch system might possibly be designed to avoid adverse effects from boundary layer drag. An appendix provided by A. C. Buckingham summarizes his calculations that predict the amount of erosive drag between projectile and rail. Finally, I found that certain properties of railgun and projectile materials can impose operational limits. Using these limits, I designed single- and multistage accelerators. Within such limits, a railgun could accelerate a 0.1-g projectile to hypervelocities.

79-90   PROCEDURE FOR THE ASSESSMENT OF MATERIAL   A. A. Parziale
CONTROL AND ACCOUNTING SYSTEMS   I. J. Sacks
UCRL-82213, July 9, 1979
Presented at the INMM Conference,
Albuquerque, NM, July 16-19, 1979

Abstract

Lawrence Livermore Laboratory has developed and tested for the United States Nuclear Regulatory Commission a procedure for the evaluation of Material Control and Accounting (MC&A) Systems at Nuclear Fuel Facilities. This procedure, called the Structured Assessment Approach, SAA, subjects the MC&A system at a facility to a series of increasingly sophisticated adversaries and strategies. A fully integrated version of the computer codes which assist the analyst in this assessment will become available in October, 1979. The concepts of the SAA and the results of the assessment of a hypothetical but typical facility are presented.

79-91   TOOLS FOR ASSESSING AND DESIGNING   D. R. Dunn
MATERIAL CONTROL PROCESSING MONITORS   J. V. Candy
UCRL-82420, July 11, 1979   R. B. Rozsa
Presented at the INMM Conference,
Albuquerque, NM July 16-19, 1979

Abstract

This paper reviews some of the computational tools developed by Lawrence Livermore Laboratory (LLL) for the assessment and design of Material Control and Accounting (MC&A) process monitoring components and illustrates their application to a Pu evaporator/concentrator unit operation.

The codes which we have developed include: (1) a general-purpose dynamic simulator for modeling the physical phenomenology of various chemical unit operations and their associated measurement systems, (2) an estimation code for simulating the operation of some modern signal processing algorithms (Kalman filter formulation), and (3) a set of detection algorithms for material loss detection. These codes can be used to address the issues of on-line material accounting and diversion detection for safeguarding SNM, and specifically with respect to arriving at meaningful performance measures. They can be used to compare state-of-the-art with state-of-the-practice and to study cost benefit tradeoffs. They are capable of treating stochastic models with nonlinear process and measurement dynamics and as a result should provide means for better designs of MC&A process monitoring components.

79-92   AN EFFICIENT NUMERICAL PROCEDURE FOR MODELING   G. J. Burke
ANTENNAS OVER LOSSY EARTH   J. N. Brittingham
UCRL-82121, July 12, 1979
Presented at the AGARD Meeting, sponsored
by NATO, Spatind, Norway, September 10-14, 1979

Abstract

When an antenna over a ground plane is modeled by the numerical solution of an integral equation, the equation kernel involves the Sommerfeld integral formulation for the field in the presence of an interface. Direct use of this formulation is limited by excessive computation time and numerical difficulties when the antenna is close to the interface. This paper describes a procedure that is fast, without compromising accuracy, and permits modeling antennas very close to the interface. An efficient interpolation technique is used to obtain the Sommerfeld integral values from a pre-computed table. Also, the dominant singular component of the field is separated out and the integration of this component over the current is done analystically to permit evaluation for wires very close to the interface. The method has been incorporated into the Numerical Electromagnetics Code (NEC).

79-93   OPTICAL AND TRANSPORT PROPERTIES OF REACTIVELY   J. Y. Leong
SPUTTERED Cu_xS J. H. Yee
UCRL-83001, July 17, 1979
Submitted for publication in the 14th IEEE
Photovoltaic Specialist Conference, San
Diego, CA, January, 1980

Abstract

The optical transmittance and Hall effect in thin film Cu_xS were measured. The films were deposited by r.f. reactive sputtering of Cu through an H_2S/AR atmosphere. The data was used to determine the optical absorption spectrum and dominant scattering mechanisms. Ionized impurity scattering dominated for $T<100$ K and optical phonon scattering for $T>100$ K.

79-94   ON-LINE SAFEGUARDING OF SPECIAL NUCLEAR   J. V. Candy
         MATERIAL: AN APPLIED ESTIMATION APPROACH   D. R. Dunn
         UCRL-82214, July 30, 1979   R. B. Rozsa
         To be published in the IEEE Proceedings

Abstract

The applicability of modern signal processing techniques to the safguards problem for a plutonium nitrate storage tank and concentrator is addressed.

The techniques involve mathematical modeling, optimal estimation of process variables, and the detection of abnormal changes in these variables due to adversary diversion. The performance of these techniques if presented for various diversion scenarios.

79-95   SPACE-CHARGE-LIMITED CURRENT AND CAPACITANCE   R. Moorthy
         IN Cu_xS/CdS SOLAR CELLS   L. D. Partain
         UCRL-83068, July 31, 1979   D. Okubo
         Submitted to the 14th IEEE Photovoltaics   D. Henderson
         Specialists Conference

Abstract

A model based on space-charge-limited current has been used to quantitatively explain the gross electrical properties of thin film, polycrystalline Cu_xS/CdS solar cells which are characterized by non-exponential J-V characteristics that display a cross over of dark and light curves and which show a forward bias capacitance that decreases with increasing bias voltage. Fitting parameter values of $6(10^{14})/cm^3$ trap density located 0.442 eV below the conduction band in a Cu compenstated region of CdS 1.33 (10^{-4}) cm thick for free electron concentrations in the $6(10^9)$ to $2(10^{10})/cm^3$ range and mobilities in the 10 to 30 cm^2V-sec range are consistent with other reported values for SCL current in polycrystalline CdS. Theoretically predicted Ohmic behavior below the trap-filled-limit voltage was found to agree with measured J-V data over four orders of magnitude. A newly developed, transient technique allowed small signal capacitance to be measured in high forward bias near the trap-filled-limit. Measured capacitances in the 10 nf/cm^2 range were found to decrease sharply (factor of 3) near the trap-filled-limit voltage in agreement with previous measurement of space-charge-limited currently in CdS. These

results imply that entirely different physical mechanisms than previously proposed control the J-V properties and conversion efficiency of these devices.

79-96   SUMMARY OF BOILING WATER REACTOR LICENSEES'   V. R. Latorre
COMMITTMENTS TO INSTALL RECIRCULATION PUMP TRIP   B. G. Mayn
SYSTEMS
UCID-18127, July 1979

Abstract

This report summarizes the committments of boiling water reactor Licensees to a request by the U. S. Nuclear Regulatory Commission for the installation of recirculation pump trip systems in those nuclear power plants that do not currently have such systems. The Licensee's schedules for system implementation, emergency procedures development, and operator training are reviewed. This report is supplied as part of the Selected Electrical, Instrumentation, and Control Systems Issues Support Program being conducted for the U. S. Nuclear Regulatory Commission by Lawrence Livermore Laboratory.

79-97   GENERATION OF FAULT TREES FOR NONCOHERENT   M. H. Dittmore
SYSTEMS
UCRL-82211, July 1979
Published in the IEEE Transactions on Reliability

Abstract

The methodology presented in this paper provides a step-by-step procedure for generating fault trees for coherent and noncoherent sytems as well as for hardware and nonhardware systems. Nonhardware systems include accounting and procedural systems.

A block diagram is generated for the system description. Potential system failures are introduced as conditional gains of the transfer functions of the system components.

A transform graph, which we called a logical diagram is generated from the block diagram. Nonhardware systems are modeled directly as logic diagrams.

79-98   LOCATING A HORIZONTAL BOREHOLE IN THE EARTH   E. L. Laine
USING HIGH-FREQUENCY ELECTROMAGNETICS PROBING   J. T. Okada
FROM VERTICAL BOREHOLES
UCRL-82304, August 1, 1979
To be published in Mining Engineering

Abstract

The high-frequency locating of holes was very successful, showing immediately the large error in compass-logging error in the

deviation of the horizontal borehole. The computed distance and position of the horizontal hole was verified by gamma ray probing from the horizontal hole to the nearest vertical hole. A gamma ray probe would operate only about 1.5 m and it could not be used in the initial probes because of this limitation. The highest frequency used was 10 MHz, although in other media such as dry granite, frequencies as high as 450 MHz could be used over similar distances with better resolution. With two holes there are two solutions to the position equation and unless these holes are known to straddle the source, three holes are needed to remove the ambiguity.

79-99   NON-DESTRUCTIVE SEM MEASUREMENT OF MINORITY   L. D. Partain
        CARRIER TRANSPORT PARAMETERS OF Cu_xS/CdS G. A. Armantrout
        SOLAR CELLS AS A FUNCTION OF HEAT TREATMENT   D. Okubo

Abstract

Electron-beam-induced-current techniques of a scanning electron microscope have been extended to allow non-destructive measurements to be performed on P-N heterojunction devices consisting of thin layers sensitively influenced by surface effects and under conditions where junction collection efficiency is less than perfect. When applied to Cu_xS/CdS solar cells formed on polycrystalline CdS with an epitaxial Cu_xS layer that was heat treated at 180 °C in a hydrogen argon ambient, the dominant change was found to be the greater than two increases in junction collection efficiencies to a maximum and then a decrease for treatment times up to 120 minutes. No significant variations were found in the minority carrier diffusion lengths which remained in the 0.20 to 0.26 micron range for the Cu_xS and in the 0.41 to 0.46 micron range in the CdS. The Cu_xS surface recombination velocity retained a constant magnitude equal to its diffusion velocity. Optimization of the collection efficiency changes should lead to improved device performance.

79-100 Cu_xS/CdS CELL FORMATION UTILIZING REACTIVE   G. A. Armantrout
         SPUTTERING TECHNIQUES - TECHNICAL STATUS REPORT   L. D. Partain
         CONVERTING THE PERIOD OF 6/30/78-3/31/79   J. H. Yee

Abstract

During this period, extensive equipment modifications were performed to allow the direct fabrication of all-sputtered Cu_xS/CdS cells. The best all-sputtered cell had an efficiency of ~0.5%. The principal problem is associated with low short circuit current caused by high interface and space charge region

(SCR) losses. Indium doping for the sputtered CdS resistivity control was found to be unsatisfactory.

The EBIC measurements were improved with a new deconvolution approach. The significant results of the EBIC analysis of a number of samples were: 1) $L_e(Cu_xS)$ is relatively constant in the 0.1 to 0.25 μm range for the measured cells, 2) interface losses were the most important and varied by 3 to 4 orders of magnitude between different cells and by 2 orders of magnitude within the same cell with heat treatment, and 3) SCR losses vary by over an order of magnitude between samples and following heat treatment. Junction I-V mechanisms were investigated experimentally and theoretically and were best explained by a space-charge-limited current region in series with an ideal diode. The presence and properties of the space-charge limited current control the maximum efficiency attainable from a given device.

Theoretical calculations of maximum cell performance were performed using present knowledge and results. They showed that the efficiency of a planar junction structure would be limited to less than 8% unless $L_e(Cu_xS)$ can be significantly increased or V_{oc} increased by some means such as the use of a mixed sulfide substrate.

Present work involves determining the cause of the high interface loss on unetched cells, determining the maximum attainable value of $L_e(Cu_xS)$, and assessing the overall utility of forming a Cu_xS/CdS cell using reactive sputtering techniques.

79-101 ITERATIVE RAY TRACING FOR UNDERGROUND IMAGE RECONSTRUCTION
R. J. Lytle
K. A. Dines
UCRL-83002, August 14, 1979
To be published in the IEEE Transactions on
Geoscience and Electronics

Abstract

A computerized method is described for calculating an image of the refractive index distribution in a plane bounded by two underground boreholes. The scanning geometry is assumed to be limited to probing from borehole to borehole, with rays at numerous depths and angles to effectively cover the cross section between holes. A geometrical optics model is assumed for the transmission data. We stress situations where significant bending of electromagnetic or seismic rays occurs. Image reconstruction involves an iterated sequence of numerical ray tracing and linear system inversion. A similar approach, discussed in the literature, sometimes fails to converge. We report here our refinements of this method, including use of a smoothness constraint. Reconstructions from synthetic data illustrate the improvement in image quality that can be obtained when ray bending is taken into account. Results are shown for several refractive index contrasts and levels of data noise.

79-102   CURRENT ON THIN, INFINITE-LENGTH WIRE EMBEDDED   J. N. Brittingham
       IN AN INTERFACE FROM PLANE WAVE EXCITATION   F. V. Schultz
         UCRL-80420, Rev. 1, August 14, 1979
         To be published in the Radio Science

Abstract

A recently developed series representation for the Sommerfeld integrals and a thin-wire model are used to calculate the current on an infinitely long thin wire embedded in an interface between two media. The wire is excited by a plane wave incident from the free-space side of the interface. Numerical results are presented.

79-103   PROBABILITISTIC APPROACH TO EMP ASSESSMENT   R. M. Bevensee
         UCRL-52804, August 19, 1979   H. S. Cabayan
                                                    F. J. Deadrick
                                                    L. C. Martin
                                                    R. W. Mensing

Abstract

The development of nuclear EMP hardness requirements must account for uncertainties in the environment, in interaction and coupling, and in the susceptibility of subsystems and components. Typical uncertainties of the last two kinds are briefly summarized, and an assessment methodolgy is outlined, based on a probabilistic approach that encompasses the basic concepts of reliability. It is suggested that statements of survivability be made compatible with system reliability. Validation of the approach taken for simple antenna/circuit systems is performed with experiments and calcuations that involve a Transient Electromagnetic Range, numerical antenna modeling, separate device failure data, and a failure analysis computer program.

79-104   ON-LINE STRUCTURAL PARAMETER ESTIMATION   J. V. Candy
       USING THE EXTENDED KALMAN IDENTIFIER
         UCRL-83254, August 21, 1979
         Submitted for publication in The Journal
         of Sound and Vibration

Abstract

This paper discusses the development of on-line state and parameter estimators used to analyze the structural response of buildings. The estimator/identifier is an extended Kalman filter (EKF), which has been applied with great success in other technological areas. It is shown that the EKF can perform quite well on simulated noisy structural response data.

79-105   THE POTENTIAL FIELD AROUND SUBSURFACE,   R. J. Lytle
       ELECTRICALLY EXCITED CONDUCTORS   J. T. Okada
         UCRL-83191, August 24, 1979   C. Concepcion
           To be published in the IEEE Transactions
          on Geoscience Electronics

Abstract

A simple mathematical model has been developed for determining the depth and radius of an excited electrical conductor (e.g., a grout ball) located underground. The method uses voltage profiles, measured on the ground surface or in boreholes, and it is expected to be more accurate than conventional four-probe resistivity surveys.

79-106 TECHNICAL EVALUATION OF THE ELECTRICAL,   V. R. Latorre
        INSTRUMENTATION, AND CONTROL DESIGN ASPECTS   B. G. Mayn
        OF THE LOW TEMPERATURE OVERPRESSURE PROTECTION
        SYSTEM FOR THE MAINE YANKEE NUCLEAR POWER PLANT
            UCID-18131, August 1979

Abstract

This report documents the technical evaluation of the electrical, instrumentation, and control design aspects for the low temperature overpressure protection system of the Maine Yankee nuclear power plant. Design basis criteria used to evaluate the acceptability of the system included operator action, system testability, single failure criterion, and seismic Category I and IEEE Std-279-1971 criteria. This report is supplied as part of the Selected Electrical, Instrumentation, and Control Systems Issues Program being conducted for the U. S. Nuclear Regulatory Commission by Lawrence Livermore Laboratory.

79-107 TECHNICAL EVALUATION OF THE ELECTRICAL,   V. R. Latorre
        INSTRUMENTATION, AND CONTROL DESIGN ASPECTS   B. G. Mayn
        OF THE LOW TEMPERATURES OVERPRESSURES PROTECTION
        SYSTEM FOR THE YANKEE ROWE NUCLEAR POWER PLANT
            UCID-18132, August 1979

Abstract

This report documents the technical evaluation of the electrical, instrumentation, and control design aspects for the low temperature overpressure protection system of the Yankee Rowe nuclear power plant. Design basis criteria used to evaluate the acceptability of the system included operator action, system testability, single failure criterion, and seismic Category I and IEEE Std-279-1971 criteria. This report is supplied as part of the Selected Electrical, Instrumentation, and Control Systems Issues Program being conducted for the U. S. Nuclear Regulatory Commission by Lawrence Livermore Laboratory.

79-108 LINEAR WEIGHTED LEAST-SQUARES ESTIMATION   T. A. Doerr
            UCID-18257, August 1979

Abstract

The linear weighted least-squares estimator is developed and compared to the minimum variance estimate. A sequential form of the estimator. The sequential least-squares estimate is implemented within an existing Kalman filtering code called DYNEST (1),(5). Numerical examples are provided for the comparison of the estimators.

79-109   A 250 MHz FOR TRANSIENT RECORDING   C. F. McConaghy
         UCRL-83315, September 13, 1979   J. W. Balch
         To be published in the IEEE Int'l
         Solid-State Circuits Conference

Abstract

A four phase buried channel CCD has been fabricated and shown to have .9999 charge transfer efficiency at clock frequencies up to 250 MHz. The response time of the device's input structures has been measured to be less than one nanosecond. Computer correction of dark current offset, channel to channel gain, and fixed pattern noise will be shown.

79-110   SYMMETRY CONDITIONS FOR TWO-DIMENSIONAL   D. M. Goodman
         FIR FILTERS
         UCID-18311, September 14, 1979

Abstract

Necessary and sufficient conditions for the magnitude response of a two-dimensional finite impulse response digital filter to have quadrual, diagonal or octagonal symmetry are developed. These conditions impose symmetry constraints on the filter coefficients thereby lowering the number of parameters which must be determined in designing such filters.

79-111   IDENTIFICATION, DETECTION, AND VALIDATION OF   J. V. Candy
         VIBRATING STRUCTURES: A SIGNAL PROCESSING   D. L. Lager
         APPROACH
         UCID-18270, September 18, 1979

Abstract

This report discusses the application of modern signal processing techniques to characterize parameters governing the vibrational response of a structure. Simulated response data is used to explore the feasibility of applying these techniques to various structural problems. On-line estimator/identifiers are used to estimate structural parameters, validate designed structures, and detect structural failure when used with a detector.

79-112 APPLICATION OF TIME DOMAIN PARET TO THE MEASURED   D. L. Lager
        RESPONSES OF A BUILDING
            UCID-18271, September 18, 1979

Abstract

The Time Domain PARET (TDP) algorithm was applied to the measured
vibratory responses of a three story reinforced concrete building
for the purpose of determining the natural modes and mode shapes of
the structure. The responses were obtained by Agbabian Associates
using a mass sliding down a rod against a set of cutters to
generate an exitation consisting of a train of impulses.

The TDP algorithm was used to process the waveforms that showed a
satisfactory coherence function over the frequency range of 5 to
18.8 Hz. The algorithm produced good fits to the data at several
values of Npoles (i.e., at several choices for the number of modes
of vibration). More data of higher quality must be obtained to
make the choice of the most physically meaningful value for the
number of modes.

Plots of the raw data, filtered data, coherence functions, pole
clusters, and frequency spectra are given. Also comparisons in
both time and frequency domains between the filtered data and
simulations obtained from the extracted modes are given.

79-113 THE ZOOM TRANSFORM AS A PREPROCESSOR FOR PARET   W. D. Smith
            UCID-18272, September 18, 1979   D. L. Lager

Abstract

The PARET algorithm for extracting mode or singularity parameters
from a sampled record of transient experimental data has difficulty
with data containing modes that are closely spaced in frequency
relative to their absolute frequencies. We felt that preprocessing
the data with the so-called Zoom Transform might improve the
performance of the PARET algorithm in such cases. This report
describes a study we carried out to determine the benefits of
"zooming" to mode parameter estimation. The results suggest that
zooming can greatly enhance the power of the PARET algorithm for
certain types of data and should be implemented as a user option.

79-114 STATISTICAL FAILURE ANALYSIS OF MILITARY   H. S. Cabayan
        SYSTEMS FOR HIGH-ALTITUDE EMP   F. J. Deadrick
            UCRL-82499, September 18, 1979   L. C. Martin
            Presented at the 1979 EOS/ESD   R. W. Mensing
            Symposium, Denver, CO, September 25-27, 1979

Abstract

The Lawrence Livermore Laboratory under contract to the Defense
Nuclear Agency is to provide system tools to assess the impact of

uncertainty on the vulnerability assessment of military systems to high-altitude nuclear EMP in order to improve the confidence in establishing hardening requirements. The use of probabilistic analysis to achieve the above is outlined and illustrated in this paper.

79-115   MULTIDIMENSIONAL SPECTRAL FACTORIZATION   D. M. Goodman
         AND UNILATERAL AUTOREGRESSIVE MODELS   M. P. Ekstrom
              UCRL-82412, September 19, 1979
              Published in the IEEE Trans. on Automatic
              Control, April, 1980

Abstract

In this paper we present a procedure for the spectral factorization of multidimensional spectral density functions. We develop and use properties of the multidimensional cepstrum as a basis for the procedure. The resulting factors, like those of Wiener's one-dimensional factorization, are stable and realizable (i.e., recursible). We describe a numerical algorithm for performing the factorization and indicate its use in obtaining unilateral representations of multidimensional random fields.

79-116   2-D DIGITAL SIGNAL PROCESSING WITH AN ARRAY   R. E. Twogood
         PROCESSOR
              UCRL-83349, September 20, 1979
              Published in the 1980 Int'l Conf. on
              Acoustics, Speech, & Signal Processing,
              Denver, CO, IEEE ASSP Society, April 9-11, 1980

Abstract

The applicability of array processor (AP) technology to 2-D digital signal processing is investigated in this paper. The implementations of several key image processing algorithms are discussed, with emphasis on how the algorithms mesh with the AP architecture and the various trade-offs involved. The AP implementations of the algoriths are compared with the more standard minicomputer and large scientific computer implementations, indicating that array processors are extremely cost-effective for image processing applications.

79-117   SYMMETRY CONDITIONS FOR 2-D RECURSIVE FILTERS   M. P. Ekstrom
              UCRL-83350, September 20, 1979
              Presented at the 1980 Int'l Conf. on
              Acoustics, Speech, & Signal Processing,
              Denver, CO, IEEE ASSP Society, April 9-11, 1980

Abstract

This paper describes necessary and sufficient conditions under which two-dimensional (2-D) recursive filters have prescribed

symmetries in their frequency responses. Two principal classes of
symmetry are considered: quadrantal (4-fold) symmetry and
octagonal (8-fold) symmetry. Appropriate conditions for both
symmetries are developed using the so-called "8-factor" spectral
factorization of 2-D amplitude spectra and some mapping properties
of the 2-D cepstrum. Special emphasis is placed on describing the
significant practical benefits from using these conditions in
reducing the complexities of filter design and implementation.

79-118   COMPUTER PROGRAM NEWSLETTER NO. 2   W. G. Magnuson, Jr.
         UCID-18298-79-2, September 1979

Abstract

This issue of the computer program (code) newsletter focuses on
electrical network analysis using digital computer programs. In
particular, five network analysis programs will be described
(SCEPTRE, SPICE2, NET-2, CALAHAN, and EMTP). The objective of the
program description of the input newsletter will be to provide a
very brief description of the input syntax and semantics, highlight
the strong and weak points, and to illustratre how the programs can
be used at Lawrence Livermore Laboratory.

79-119   SAFEGUARDS MATERIAL CONTROL AND ACCOUNTING   D. R. Dunn
         PROGRAM: QUARTERLY REPORT JULY-SEPTEMBER, 1979
         UCRL-52715, September 1979

Abstract

Activity for the quarter July-September 1979 in the Material
Control Safeguards Evaluation Program, conducted for the U.S.
Nuclear Regulatory Commission (NRC) at Lawrence Livermore National
Laboratory, is summarized. Progress was made in developing a
computer-based methodology for identifying vulnerabilities in
Material Control and Accounting (MC&A) systems in nuclear
fuel-cycle facilities. This progress took the form of deliverables
reporting work completed in the Structured Assessment Approach
(SAA) methodology, and a Phase II Safeguards Vulnerability
Assessment Methodology (SVAM) application of G.E. Vallecitos
Nuclear Center. Moreover, SVAM was developed into a computer-based
assessment strategy called Safeguards Vulnerability Analysis
Program (SVAP). Work continued in assisting the NRC to develop the
forthcoming MC&A upgrade rule. Other areas of activity reported on
here are aggregated systems model development, adversary modeling,
and components performance.

79-120   SAFEGUARDS DESIGN FOR A PLUTONIUM NITRATE   J. V. Candy
         CONCENTRATOR UNIT - AN APPLIED ESTIMATION   R. B. Rozsa
         APPROACH
              UCRL-82230, September 1979
              To be published in the IFAC Journal
              Automatic, November, 1980

Abstract

In this paper we consider the design of a nonlinear estimator to be used in conjuction with on-line detectors for a plutonium-nitrate concentrator. Using a complex state-of-the-art process model to simulate "realistic" data, we show that the estimator performance using a simplified process model is adequate over a wide range of operation. The estimator is used to simulate and characterize some on-line diversion detectors, i.e., detectors designed to indicate if some of the critical special nuclear material in process is stolen or diverted from the unit. Simulation results indicate that the estimators and detectors yielded reasonable performance for the scenarios investigated.

79-121   PROSPECTS FOR GENERATING 1-10 TPa PRESSURE   R. S. Hawke
WITH A RAILGUN   J. K. Scudder
      UCRL-82296, October 2, 1979
      Published in the proceeding's of the Int'l
      High Pressure AIRAPT Conference, LeCreusot,
      France, July 30-August 3, 1979

Abstract

It has been demonstrated that a plasma arc can be accelerated along two current carrying parallel rails and used to accelerate a projectile. We have performed an extension analysis and found the prospects of using a railgun to accelerate an impactor plate to velocities of 10-40 km/s to be feasible with contemporary technology. This range of impact velocities would enable shock pressures of 1-10 TPa to be generated for EOS research.

79-122   THE AGGREGATED SYSTEMS MODEL A TOOL FOR   R. A. Al-Ayat
NUCLEAR SAFEGUARDS DECISION-MAKING   B. Judd
      UCRL-82212, October 4, 1979
      Presented at the ANS Conference, San
      Francisco, CA, November 11-16, 1979

Abstract

Setting performance criteria for systems that safeguard special nuclear material (SNM) involves many considerations: characteristics of adversaries attempting to divert SNM, safeguards response to attempts, costs of safeguards systems, and the consequences of diverted SNM. This paper describes an Aggregated Systems Model which is designed to assist decision makers integrate and evaluate consistently these diverse factors. Results from applying the model to a hypothetical facility handling SNM are summarized. The paper also describes a new performance criterion designed to measure the effectiveness of a safeguard system in deterring adversaries.

79-123   SAFEGUARDS RESEARCH AT LLL   J. G. Huebel
          UCRL-82224, October 4, 1979   D. R. Dunn
          Presented at the 2nd ESARDA Symposium on
          Safeguards and Nuclear Materials Management,
          Edinburgh, Scotland, March 26-28, 1980

Abstract

This paper presents an overview of the Lawrence Livermore
Laboratory's safeguards research for the U.S. Nuclear Regulatory
Commission (NRC) in the area of Material Control and Accounting.
We describe tools that the NRC can use to assess compliance of
safeguard plans for commercial nuclear fuel facilities and to
formulate an upgraded set of material control ahd accounting
regulations.

79-124   REAL TIME LOSS DETECTION FOR SNM IN PROCESS   J. V. Candy
          UCRL-82225, October 4, 1979   D. R. Dunn
          Presented at the 2nd ESARDA Symposium on   D. T. Gavel
          Safeguards and Nuclear Materials Management,
          Edinburgh, Scotland, March 26-28, 1980

Abstract

In this paper we discuss the design of real time special nuclear
material (SNM) loss detectors. The detectors utilize process
measurements and signal processing tecniques to produce a timely
estimate of material loss. A state estimator is employed as the
primary signal processing algorithm. Material loss is indicated by
changes in the states or process innovations (residuals). The
detectors are applied to typical nuclear reprocessing/fabrication
chemical processing units.

79-125   PERFORMANCE EVALUATION OF SNM LOSS DETECTION   D. T. Gavel
          SCHEMES
          UCRL-82226, October 4, 1979
          Presented at the the 2nd ESARDA Symposium on
          Safeguards and Nuclear Materials Management,
          Edinburgh, Scotland, March 26-28, 1980

Abstract

This paper presents four loss detection schemes for Special Nuclear
Material (SNM) accounting at a nuclear fuel cycle plant. To
evaluate detector performance, we employ these schemes in a
hypothetical SNM loss scenario around a concentrator and precipator
unit operation.

79-126   THE STRUCTURES ASSESSMENT APPROACH - A   A. A. Parziale
          PROCEDURE FOR THE ASSESSMENT OF FUEL CYCLE   C. J. Patenaude
          SAFEGUARD SYSTEMS   P. A. Renard
          UCRL-82222, October 5, 1979

Presented at the 2nd ESARDA Symposium on
Safeguards and Nuclear Materials Management,
Edinburgh, Scotland, March 26-28, 1980

Abstract

Lawrence Livermore Laboratory has developed and tested for the
United States Nuclear Regulatory Commission a procedure for the
evaluation of Material Control and Accounting (MC&A) Systems at
Nuclear Fuel Facilities. This procedure, called the Structured
Assessment Approach, SAA, subjects the MC&A system at a facility to
a series of increasingly sophisticated adversaries and strategies.
A fully integrated version of the computer codes which assist the
analyst in this assessment was made available in October, 1979.
The concepts of the SAA and the results of the assessment of a
hypothetical but typical facility are presented.

79-127   VALUE-IMPACT ANALYSIS FOR SAFEGUARDS RULES   R. A. Al-Ayat
            UCRL-82223, October 5, 1979   B. Judd
            Presented at the 2nd ESARDA Symposium on   J. Huntsman
            Safeguards and Nuclear Materials Management,
            Edinburgh, Scotland, March 26-28, 1980

Abstract

This paper summarizes a quantitative tool developed at Lawrence
Livermore Laboratory to help the U.S. Nuclear Regulatory Commission
establish regulations for safeguarding Special Nuclear Material
(SNM). This technique, Value-Impact Analysis, provides a
decision-maker with a framework for consistently evaluating the
trade-off between the value (benefits) and impact (cost) of
safeguards rules. Sample value-impact results of demonstrating the
methodology at a facility handling SNM to evaluate possible
safeguards rule is given.

79-128   ELECTRICAL CONDUCTIVITY IMAGING   K. A. Dines
            UCRL-83318, October 5, 1979   R. J. Lytle
            To be published in Geophysics

Abstract

In this paper, we investigate the feasibility of imaging the
electrical conductivity in a cross section of an object (such as in
a core sample) by numerical inversion of low-frequency,
electromagnetic boundary data. Current flow is assumed to be
confined to the cross section, which is modeled as a network of
resistors. The network serves as a discrete approximation to the
distributed-parameter system that is described mathematically by
Maxwell's equations for steady current flow in a nonhomogeneous
medium. A complete set of linearly independent voltage vectors is
applied to the peripheral nodes, and the resulting node currents
serve as the measured data for estimating the internal conductivity
pattern (image).

79-129 SPACE-CHARGE-LIMITED CURRENT AND CAPACITANCE   R. Moorthy
        IN Cu_xS/CdS SOLAR CELLS   L. Partain
            UCRL-83473, October 5, 1979   D. Okubo
            Presented at the 1979 Int'l Electron   D. Henderson
            Devices Meeting, Washington, DC,
            December, 1979

Abstract

The unusual behavior of Cu_xS/CdS solar cells is better described
with space-charge-limited current (SCL I) than with standard
junction models. The SCL I theory provides the first quantitative
explanation of these devices' I-V characteristics including their
non-exponential form, the dark-light crossover, the temperature
independent slope in addition to qualitatively modeling the voltage
variation of capacitance. This is accomplished with trapping
parameter values well known to be characteristic of Cu compenstated
CdS. It indicates that the voltage dependence of current is
controlled by mechanisms entirely different than previously
proposed with important implications for device fabrication and
optimization and ultimate device performance.

79-130 WATER-EPM: THE INCORPORATION OF WATER INTO AN   M. D. Schrot
        ENERGY POLICY MODEL
            UCRL-83469, October 12, 1979
            Presented at the ORSA/TIMS Joint Nat'l
            Meeting, Milwaukee, WI, October 15-17, 1979

Abstract

This paper describes the construction of the first version of
WATER-EMP, a regionalize dynamic equilibrium model of the energy
sector of the U.S. economy coupled with pertinent aspects of the
water sector. The workings of the modeling system and the approach
to modeling water resources are outlined.

79-131 ON-LINE SAFEGUARDING OF A PULSED EXTRACTION   J. V. Candy
        COLUMN - AN APPLIED ESTIMATION APPROACH   R. A. Emmert
            UCRL-82229, October 1979   G. K. Patterson
            To be published in the IEEE Trans. on
            Automatic Control

Abstract

In this paper we consider the design of nonlinear estimators to be
used with an on-line detector for the purpose of safeguarding a
pulsed extraction column - a common unit found in nuclear
reprocessing/fabrication plants. The estimators serve a two-fold
purpose: (1) to provide an accurate account of the material
present in the column (material accounting), and (2) to help
provide the timely detection of material losses (diversion
detection).

The estimators - extended and linearized Kalman filters - are compared for estimation precision and signal enhancement capabilities. A simulated diversion of material is considered applying both estimators in conjunction with a sequential detector.

79-132 120 keV HELIUM-3 NEUTRAL BEAM INJECTOR
DESIGN STUDY
UCRL-83456, October 1979

A. S. Blum
W. L. Barr
W. L. Dexter
J. H. Fink
R. W. Moir
T. P. Wilson

Abstract

The design of a 120 keV - 2.3 MW ^{3}He neutral beam injector for use on a fusion reactor has been studied. The high sputtering rate of helium forces trade-offs between beam current and operating life (50 ma/cm^2 and 150 days) and requires the addition of a grid to prevent the flow of ions from the neutralizer duct to the electron suppressor grid. The grid wires are hollow and contain the elements of a mercury beat pipe to transfer heat out of the portion of the grid immersed in the beam. With power supplies losses included, an injection efficiency of 53% is predicted.

79-133 CONDITION FOR TWO-DIMENSIONAL PHYSICAL
REALIZABILITY
UCRL-82803, November 2, 1979
Presented at the the 13th Asilomar
Conference on Circuits, Systems, and
Computers, Naval Post-Graduate School
and University of Santa Clara, Pacific Grove,
CA, November 5-6, 1979

M. P. Ekstrom

Abstract

This paper deals with the issues of physical realizability and causality as they arise in two-dimensional (2-D) digital signal processing. A canonical model for a 2-D digital signal processor is adopted, which includes a mapping operator, mapping the 2-D data into a 1-D sequence. By incorporating this operator, the classical concept of 1-D causality can be extended directly to the 2-D case. Both spatial and transform domain conditions are developed for mappings commonly used in applications.

79-134 M-DIMENSIONAL LINEAR SYSTEMS: DETERMINATION OF
IMPULSE RESPONSE SUPPORT, COMPUTING CEPSTRA,
& RECURSIBILITY ISSUES
UCRL-83549, November 2, 1979
Presented at the 13th Asilomar Conference on
Circuits, Systems, and Computers, Naval Post-
Graduate School and University of Santa Clara,
Pacific Grove, CA, November 5-6, 1979

D. M. Goodman

Abstract

Conditions for the cepstrum of a bounded-support M-D sequence to exist and be ℓ^1 (absolutely summable) are developed, and the support of the cepstrum is related to the support of the ℓ^1 inverse of this sequence. The case in which the cepstrum can be computed recursively is discussed, and a general stability theorem for all-pole recursible difference equations is developed.

79-135 ELECTRONIC AND OPTICAL PROPERTIES OF   J. Y. Leong
POLYCRYSTALLINE Cu_xS AND Cu_xS/CdS L. D. Partain
SOLAR CELLS   J. H. Yee
UCRL-83676, November 1979
Presented at the ElectroChemical Society
Symposium on Elect. & Optical Prop.
& Impure Semic. St. Louis, MO, May, 1980

Abstract

Minority carrier diffusion lengths of $0.22\mu m$ in Cu_xS and $0.43\mu m$ in CdS and the cell junction collection efficiency of 50% were measured by SEM EBIC. Majority carrier concentration and mobility in Cu_xS from 77K to 300K were determined by Hall effect studies. The temperature dependence of mobility is fitted to ionized impurity scattering for $T<100K$ and optical phonon scatter for $T> 100K$. The optical absorption spectrum of Cu_xS, derived from transmittance and reflectance data, identified an indirect gap at 1.15eV, a direct gap at 1.25eV, and an electron effective mass of 0.5 times the rest mass.

79-136 IMAGING OF LINEAR SOURCE DISTRIBUTIONS   E. K. Miller
UCRL-52822, November 1979   D. L. Lager
                                                       J. T. Okada

Abstract

An approach based on Prony's method is used to find the spatial poles of straight wires of varying length and radius from the far-field patterns. For the antenna case, poles having the largest residues are found near the feed region and antenna ends; smaller ones are found outside these regions. The poles are attributed to radiation from the exciting source and wire ends, due to charge acceleration, and from a slightly damped traveling wave. In the scattering case, the poles with the largest residues are located at the wire's ends for near-axial incidence and are again due to end radiation. By examining the residue magnitudes as a function of wire radius, a correlation is found with radiation from the feed region of an infinite antenna and from the ends of a semi-infinite antenna.

79-137 DYNEST1-A REVISED DYNAMIC ESTIMATOR   D. W. Freeman
        CALCULATION PROGRAM   J. V. Candy
            UCRL-52721, November 1979
            Prepared for the U.S. Nuclear Regulator
            Commission

Abstract

This report is a user's guide for the DYNEST1 computer code
(DYNamic ESTimator, revision 1). DYNEST1 is a program developed at
Lawrence Livermore Laboratory to calculate state estimates of a
(nonlinear or linear) dynamic system from noisy measurement data.
The estimates, their corresponding errors, and diagnostic data are
presented primarily in graphical form, but numeric output data are
also generated. DYNEST1 implements three sophisticated on-line
state estimation algorithms: the extended Kalman filter, the
iterated extended Kalman filter, and the linearized Kalman filter.
Program modularity facilitates interfacing of user-supplied
subroutines. The versatile integration package enables the user to
calculate state estimates and associated errors at or between
measurement times. A feature is provided to calculate the
Cramer-Rao bound for linear and linearized systems. New features
of this revision include the addition of several new diagnostic
tools: a model-check capability, tracking-error plotting, and
closed-loop pole calculations. Other changes include extensive
revision of input protocol and the optional generation of
steady-state output and detector input files. The simple nonlinear
example of DYNEST1 is presented along with the necessary
subroutines. The required input, method of program execution, and
the resulting graphical output are presented.

79-138 THE STRUCTURED ASSESSMENT ANALYSIS OF FACILITY X   A. A. Parziale
            UCRL-52765, Vol. 1, Executive Summary,   I. J. Sacks
            November 1979   T. R. Rice
                                                           S. L. Derby

Abstract

This report presents the results of the assessment of the Material

Control and Accounting System of a typical facility for highly enriched nuclear fuel. The analysis of this facility was conducted using the Structured Assessment Approach developed at the Lawrence Livermore Laboratory under U.S. Nuclear Regulatory Commision sponsorship. The analysis uncovered significant vulnerabilities within the Material Control and Accounting System to an insider threat.

79-139 TWO-DIMENSIONAL FFT'S OF LARGE IMAGES WITH   R. E. Twogood
        THE AP-120B
        UCRL-83674, December 3, 1979
        Presented at the 1980 FPS Users Group Meeting,.
        San Francisco, CA, April 28-May 1, 1980

Abstract

This paper investigates the issues involved in implementing a 2-D FFT on the FPS AP-120B array processor when the data memory available is less than the image size. After a brief review of the alternative tehniques that have been proposed in the literature (with matrix transposition, without matrix transposition, vector radix), a recently developed "two-level" implementation is described. An analysis of the CPU and I/O requirements is given, showing that this algorithm is significantly superior to existing methods due to the reduced I/O requirements.

79-140 DEMONSTRATION OF THE CAPABILITIES OF THE   C. J. Anderson
        LLL ENERGY POLICY MODEL - 1979 UPDATE   R. N. Castleton
        UCRL-52508, December 14, 1979   B. L. Coles
                                                         J. T. Rambo

Abstract

Lawrence Livermore Laboratory's Energy Policy Model (EPM) has evolved substantially since July 1978, when the first "demonstration" report was issued. In this report, we discuss the updated base case and three sensitivity cases: a nuclear phase-out scenario, motivated by the incident at Three Mile Island in Harrisburg, PA; a scenario where oil imports are reduced dramatically reflecting a possible government policy; and finally, a scenario with a limitation on coal production that could result from environmental concerns. Other recent work summarized in this report includes some preliminary results of an historical comparison project, which, to some extent, validates the EPM. We examine some issues regarding convergence of the model and discuss some implications for regional analyses using the model.

79-141 THE ELECTRONICS ENGINEER'S DESIGN STATION   D. E. Bering
        UCRL-83675, December 4, 1979
        Presented at the 17th Design Automation
        Conference, Minneapolis, MN, June 23-25, 1980

Abstract

This paper describes a prototype minicomputer interactive graphics system which has been developed for the capture, formatting and dissemination of electronics design information. The principle function of this system is to bring unification to the Design Automation activities at LLL, while incorporating human factors and modern tools into the electronics design process.

The Electronics Engineer's Design Station (hereafter referred to as the Design Station) is a minicomputer based system at which LLL's engineers and designers sketch in schematic designs. Once a circuit is formed at the graphics display, the pertinent design information is extracted and used to produce schematic drawings, parts lists, signal lists, parts and signal cross references and assembly drawings as well as inputs to simulators, automated layout tools and fabrication devices. Current fabrication technologies supported include both Wirewrap and Printed Circuit methodologies.

This system is designed to expedite the low volume, fast turnaround electronics designs which are typical of LLL's research projects. However, many of the concepts of this system address problems common throughout the electronics industry.

79-142 HARD SURFACE PHOTOMASKS WITH MICRON AND   D. R. Ciarlo
        SUBMICRON LINEWIDTHS
        UCID-18491, December 18, 1979

Abstract

This report describes the procedure used to fabricate photomasks for Gallium Arsenide test chip with edge dimensions of 2.54 by 2.54 mm (100 by 100 mils) containing linewidths as small as 0.8 microns 31.5 in.) using equipment belonging to the Technical Photography Group, Room 1258, Building 121. Gallium Arsenide Metal Schottky Field Effect Transistors (GaAs MESFET's) require photomasks with micron and submicron linewidths. In addition, the research and development status of this particular project makes it neceassary to "try out" several design iterations in order to accumulate experimental data and verify theories. Each new design iteration requires a new set of photomasks. Commercial mask vendors are reluctant to work on linewidths below two microns at this time, although they will do so at a premium price ($4 K per set). Even if a commercial vendor agrees to make photomasks with one micron lines, the long delivery times encountered (several months) can seriously hurt the momentum of R&D projects.

79-143 PROBING CONCRETE WITH RADIO WAVES   E. F. Laine
        UCRL-82042, Rev. 1, December 18, 1979   K. A. Dines
        To be published in the Journal of the   J. T. Okada
        Geotechnical Engr. Div., American Society   R. J. Lytle
        of Civil Engineers

Abstract

Electromagnetic probing can be used to assess the integrity of concrete cofferdam seals. Data are taken using high-frequency transmitter and receiver antennas installed in separate boreholes drilled in the concrete seal, and the spatial variation of a signal attenuation rate is calculated using tomographic techniques applied to the concrete structure. The results map the variation of signal attenuation rate within a plane bounded by the boreholes. Experimental results using this technique on an actual cofferdam seal show anamalous regions in the concrete. One core sample confirmed this prediction for one signal profile, but a core sample in a different region did not correlate with the profile of that region. The change in electrical conductivity of concrete with time might have caused this disagreement.

79-144   TECHNICAL EVALUATION OF THE PROPOSED CHANGES   V. R. Latorre
IN THE TECHNICAL SPECIFICATIONS FOR EMERGENCY
POWER SOURCES FOR THE BIG ROCK POINT NUCLEAR
POWER PLANT
UCID-18142, December 1979

Abstract

This report documents the technical evaluation of the proposed changes to the Technical Specifications for emergency power sources for the Big Rock Point nuclear power plant. The criteria used to evaluate the acceptability of the changes include those delineated in IEEE Std-308-1974, and IEEE Std-450-1975 as endorsed by the U.S. NRC Regulatory Guide 1.129. This report is supplied as part of the Selected Electrical, Instrumentation, and Control Systems Issues Technical Assistance Program being conducted for the U.S. Nuclear Regulatory Commission by the Lawrence Livermore Laboratory.

79-145   DASLL USER'S TRAINING & PROCEDURES MANUAL   W. G. Magnuson, Jr.
UCID-18514, December 1979   G. W. Willett

Abstract

This manual is a brief description on how to use the DASLL system to layout printed circuit boards. It covers how to prepare input, how to run DASLL on the OCTOPUS CDC 7600 computer system, and how to make the DASLL system output ready for final inspection.

79-146   DASLL (DESIGN AUTOMATION SYSTEMS AT LAWRENCE   W. G. Magnuson, Jr.
LIVERMORE LABORATORY) SYSTEMS REFERENCE MANUAL   G. W. Willett
UCID-18533, December 1979

Abstract

DASLL stands for Design Automation System at Lawrence Livermore Laboratory and is a set of computer programs for the laying out of

electronic printed circuit boards. This report complements other documentation and provides information for a programmer or DA specialist who wishes to learn more about DASLL, maintain the system, or install it on another computer system. The DASLL system structure is described together with brief descriptions of the data base and internal file structures. Included also on microfiche is a complete program listing with extensive comments.

79-147 SAFEGUARDS MATERIAL CONTROL AND ACCOUNTING   D. R. Dunn
       PROGRAM: QUARTERLY REPORT OCTOBER-DECEMBER,
       1979
           UCRL-52715-79-2, December 1979

Abstract

Work is summarized for the quarter October to December, 1978, in the Material Control Safeguards Evaluation Program, conducted for the U.S. Nuclear Regulatory Commission (NRC) at Lawrence Livermore Laboratory. The main activities related to the continuing development of the assessment methodologies and their application to the assessment of a fuel cycle facility.

Much progress was made in the Digraph--Fault Tree Methodology, leading to the Safeguards System Vulnerability Assessment Methodology (SSVAM). In addition, the development of the Structured Assessment Approach (SAA) continued on schedule. Both techniques were used to assess the vulnerabilities of the safeguard system at an existing fuel recovery facility (Facility X).

Other activities during the quarter included (1) the continuing development of the Aggregated Systems Model (ASM), an evaluation tool designed to aid the NRC in the setting safeguards criteria; (2) the continuing structuring and data gathering for the adversary model portion of the ASM; and (3) the continuing development of computer codes for chemical process modeling/material estimation/material loss detection.

79-148 SAFEGUARDS VULNERABILITY ANALYSIS PROGRAM   R. M. Gilman
       (SVAP) EXECUTIVE SUMMARY   M. H. Dittmore
           UCRL-52724, December 1979   W. J. Orvis
           Published in the NRC - NUREG/CR-1087   P. S. Wahler

Abstract

The steps involved in making a Safeguard Vulnerability Analysis Program (SVAP) application to a nuclear facility are summarized. NRC analysts are expected to execute SVAP on nuclear facilities to check facility safeguard systems for soundness and to reveal vulnerabilities, if any. The ultimate objective is to create safeguard systems that will effectively deter theft or diversion of special nuclear materials. The Input Phase of a SVAP application consists of data-gathering, data recording in a handbook, and

data-entering into a Tektronix computer. At that point, the facility data are transferred to a main frame computer for processing, and in the Output Phase the main frame computer delivers a complete descriptive analysis of the facility's safeguard system, disclosing its vulnerabilities.

APPENDIX A

AUTHOR INDEX

Name	Report Number(s)
Aggarwal, S.	74
Al-Ayat, R. A.	122, 127
Anderson, C. J.	140
Armantrout, G. A.	4, 5, 25, 35
	57, 83, 100, 101
Balch, J. W.	86, 109
Barr, W. L.	132
Bering, D. E.	141
Bevensee, R. M.	17, 20, 53
	76, 103
Blum, A. S.	133
Brittingham, J. N.	16, 45, 52
	62, 92, 102
Burke, G. J.	16, 19, 23
	69, 92
Cabayan, H. S.	44, 53, 54
	64, 103, 114
Candy, J. V.	29, 32, 33, 44
	47, 48, 51, 60
	61, 66, 88, 91
	95, 104, 111, 120
	124, 131, 137
Castleton, R. N.	32, 140
Ciarlo, D. R.	142
Coles, B. L.	140
Concepcion, C.	105
Condon, J.	1
Corynen, G. C.	71, 74
Davis, D. T.	44, 53, 59
	64, 103, 114
Derby, S. L.	138
Dexter, W. L.	132
Dines, K. A.	101, 128, 143
Dittmore, M. H.	31, 97, 148
Doerr, T. A.	108
Dunn, D. R.	8, 29, 33, 49
	51, 56, 60, 87
	88, 91, 94, 119
	123, 124, 147
Ekstrom, M. P.	3, 43, 78, 115
	117, 133
Emmert, R. A.	48, 131

APPENDIX A

Author Index

Name	Report Number(s)
Fink, J. H.	132
Freeman, D. W.	137
Gavel, D. R.	124, 125
Gilman, F. M.	31, 148
Goodman, D. M.	37, 110, 115
	134
Harvey, R. G.	69
Hawke, R. S.	10, 21, 34
	67, 68, 82
	89, 121
Hegner, S. J.	74
Henderson, D.	95, 129
Huebel, J. G.	30, 33, 50, 123
Huntsman, J.	126
Judd, B.	15, 76, 121, 126
Lager, D. L.	18, 22, 63
	73, 75, 110
	111, 112, 135
Laine, E. F.	11, 60, 98, 142
Latorre, V. R.	95, 105, 106
Leong, J. Y.	36, 39, 83
	85, 93, 135
Lim, J. J.	30, 50
Logan, J. C.	23
Lytle, R. J.	1, 39, 42
	59, 72, 101
	105, 128
Magnuson, Jr., W. G.	81, 118, 145, 146
Martin, L. C.	44, 53, 103
	64, 114
Mayn, B. G.	96, 106, 107
McConaghy, C. F.	35, 86, 109
Mensing, R. W.	44, 53, 114
Miller, E. K.	12, 13, 14, 18
	19, 40, 45, 136
Mitra, S. K.	79
Moir, R. W.	132
Mondal, K.	79
Moorthy, R.	85, 95, 117, 129
Myers, G. K.	7

APPENDIX A

Author Index

Name	Report Number(s)
Nellis, W. J.	10
Newkirk, H. W.	2
Okada, J. T.	11, 59, 98
	105, 136, 143
Okubo, D.	95, 99, 129
Orvis, W. J.	9, 24, 25, 148
Partain, L. D.	36, 55, 83, 84
	95, 99, 100
	129, 135
Parziale, A. A.	26, 27, 90
	126, 138
Patenaude, C. J.	126
Patterson, G. K.	48, 131
Pimental, K. D.	60
Pocha, M. D.	86
Poggio, A. J.	23
Rambo, J. T.	140
Renard, P. A.	126
Rice, T. R.	138
Rockway, J. W.	23
Ross, D. J.	70
Rozsa, R. B.	29, 51, 61
	91, 94, 120
Sacks, I. J.	26, 27, 90, 138
Salisbury, J. D.	28, 38
Sasser, D. W.	70
Savage, J. W.	28, 38
Schrot, M. D.	130
Schultz, F. V.	102
Scudder, J. K.	10, 21, 34
	68, 121
Shea, S. P.	55
Sherwood, R. J.	70
Smith, W. D.	22, 63, 73, 113
Tindall, W. E.	58
Twogood, R. E.	3, 41, 62, 79
	81, 116, 139
Wahler, P. S.	148
Warter, P.	83
Weissenberger, S.	15, 76

APPENDIX A

Author Index

Name	Report Number(s)
Willett, G. W.	145, 146
Willows, J. L.	45
Wilson, T. P.	132
Woods, J. W.	3
Yee, J. H.	5, 6, 39
	57, 69, 85
	93, 100, 135

APPENDIX B

KEYWORD INDEX

APPENDIX B

Keyword Index

APPENDIX B

Keyword Index

APPENDIX B

Keyword Index

Keyword	Report Number(s)
Impact Fusion	21, 82, 89
Impedance Camera	128
Infrared Intrusion Detectors	56
Infralarm	56
Integrated Circuits	86
Interactive Graphics	141
Inverse Scattering	18
Isentropic Compression	67
Iterative	101
Jordan Canonical Form	47
Kalman Filter	32, 48, 51
	60, 61, 88
	108, 111, 124
Kalman Filter Algorithm	137
Kalman Filter/Identifier	66
Large Scale Systems	47
Least Squares	22, 108
Likelihood Ratio Detector	7
Linear Arrays	19
Linear Prediction	22, 40
Linear Systems	134
Linearized Kalman Filter	46
Logic Diagrams	97
Lossy Interface	102
Low Frequency	128
Low Temperature Overpressure	106, 107
MC&A Upgrade Rule	119
Magnetic Accelerator	34, 89, 121
Magnetic Compression	34
Magnetic Propulsion	21, 68, 82
Magnetic-Gradient Accelerators	65
Maine Yankee OPS	106
Material Control and Accounting	26, 27, 30, 49,
	87, 119, 123
	126, 138, 147
Mathematical Systems Theory	74
Metallic Hydrogen	67
Mobility	93
Model Analysis	75
Modeling	48, 61, 130, 140
Modeling Material Accounting	50
Modeling Methodology	74

APPENDIX B

Keyword Index

APPENDIX B

KEYWORD INDEX

APPENDIX B

KEYWORD INDEX

Keyword	Report Number(s)
Solar Cells	4, 36, 55, 69 83, 84, 95, 99 100, 135
Solid-State Mandrels	58
Sommerfeld Integrals	16, 52
Source Imaging	136
Space-Charge-Limited Current	36, 83, 95, 129
Special Nuclear Material	33
Spectral Factorization	3, 43, 115
Statistical Detection of Models	56
Structural Modes	104
Structure Vibration	112
Structured Assessement Approach	147
Susceptibility	44
System Assessment	114
System Identification	75, 112
System Structure	74
Systems Theory	71
Target Identification	40
Technical Specifications Changes	144
Technology Transfer	2
Technology of Tomography	143
Temperature Measurement	24
Thermistors	24
Thin Wire Antennas	92
Thin-Film	5, 6
Time Projection Chamber	35
Time-Domain EM	12
Transient Diagnostics	35
Transient Recorder	86, 109
Transmitter Gain-Bandwidth	20
Transport Properties of Cu_2S	85
Transport Property	5, 6
Two-Dimensional Causality	133
Two-Dimensional Fast Fourier Transforms	41, 116, 139
Two-Dimensional Filters	37, 41, 110
Two-Dimensional Quandrantal & Octagonal Symmetry	117
Two-Dimensional Realizability	43
Two-Dimensional Recursive Filters	117
Two-Dimensional Spectral Factorization	79, 117
Two-Dimensional Wiener Filter	43
Uncertainties in EMP	44, 53
Value-Impact	127

APPENDIX B

KEYWORD INDEX